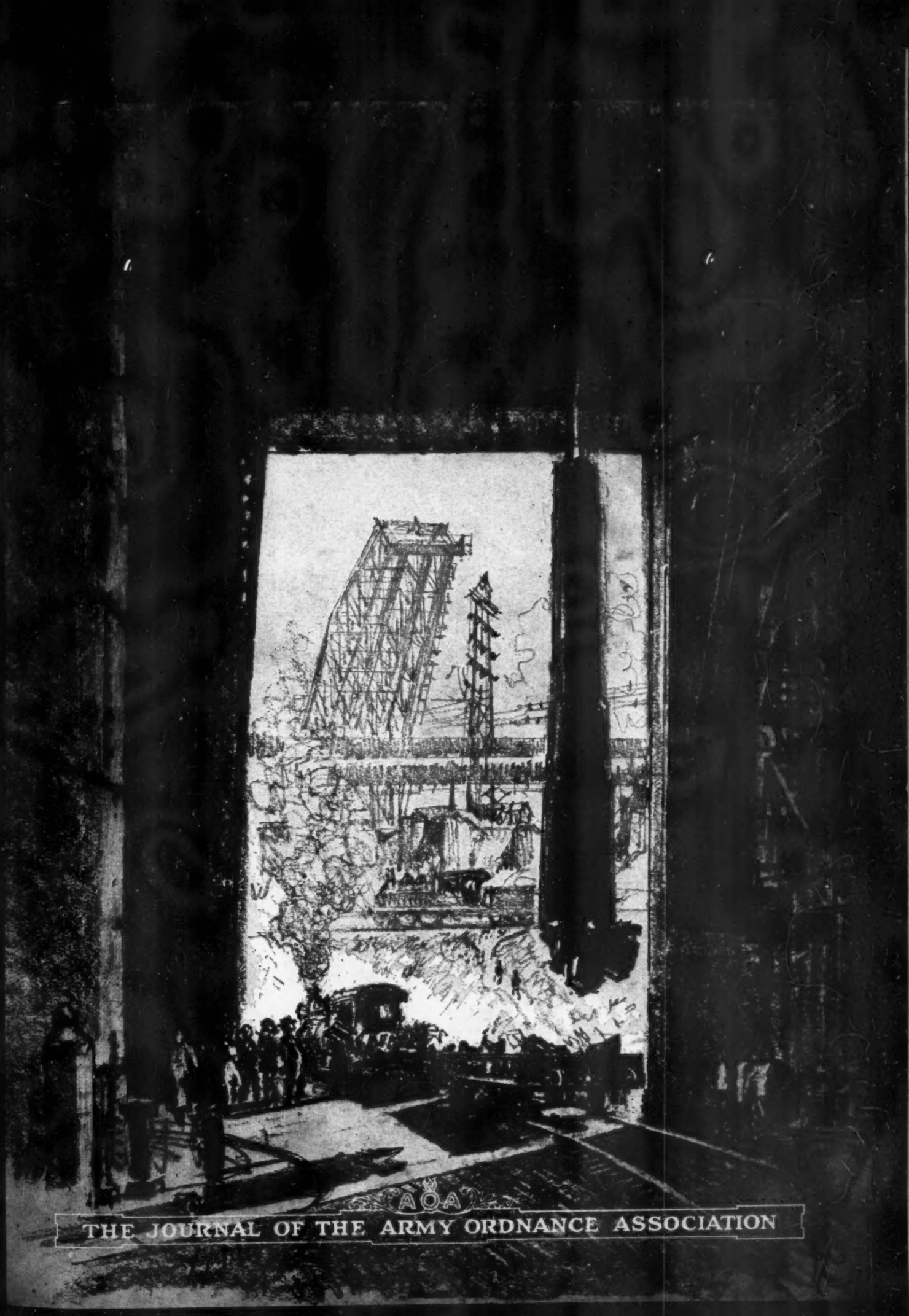
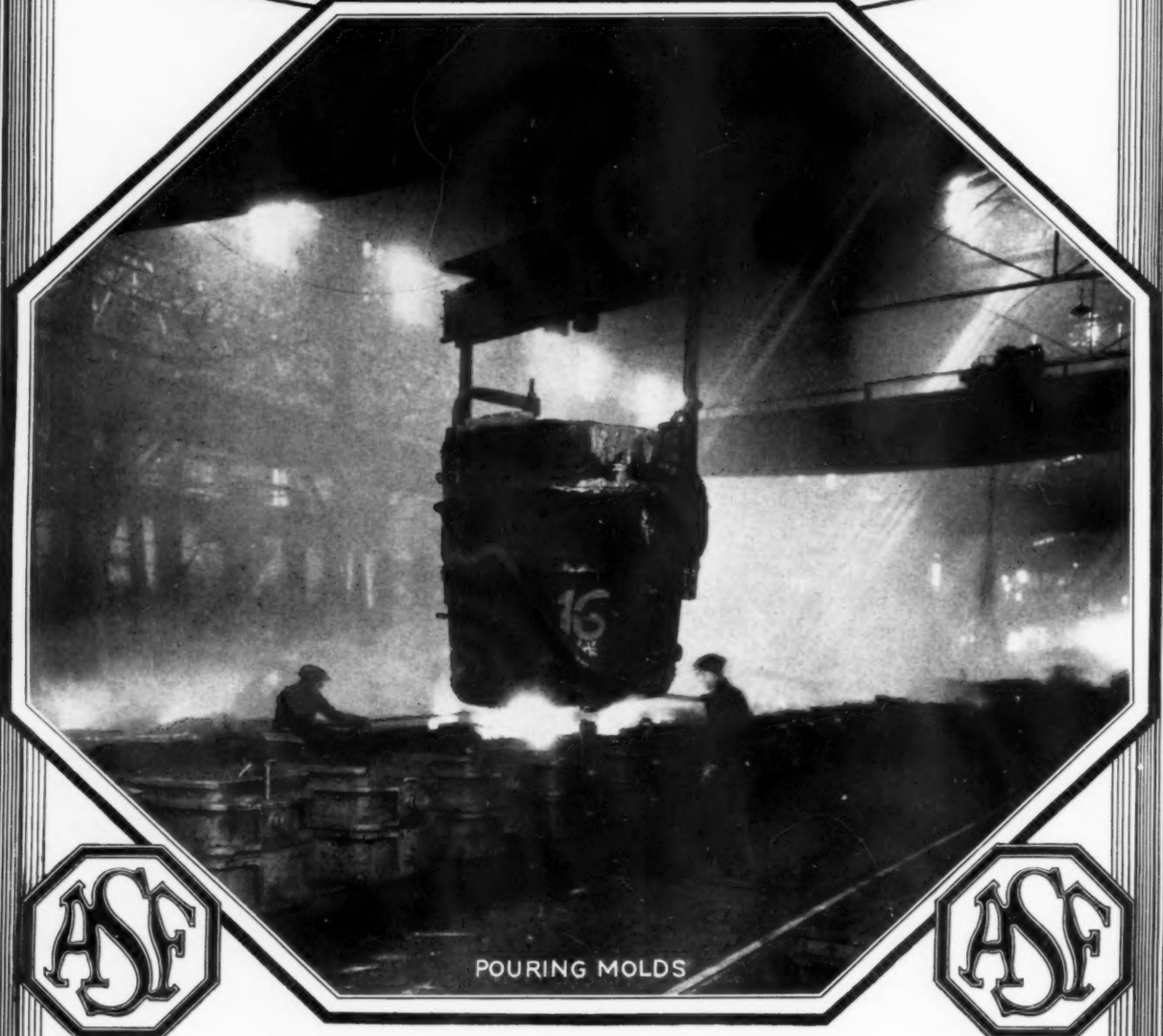

AOA
THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

AMERICAN STEEL FOUNDRIES

NEW YORK CHICAGO ST. LOUIS



POURING MOLDS

STEEL CASTINGS OF EVERY DESCRIPTION
FOR
ARMY AND NAVY REQUIREMENTS

ARMY ORDNANCE

The Journal of the Army Ordnance Association

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

Published by
THE ARMY ORDNANCE ASSOCIATION
806 Mills Building, Washington, D. C.

C. R. Baxter
Editor

L. A. Codd
Associate Editor

Authors alone are responsible for statements made and opinions expressed in their respective articles.

Issued Bimonthly. Single Copy 75c.
Subscription rate: Continental U. S. $4.50 per annum, foreign $5.00, in advance. Entered as second-class matter August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional entry at Richmond, Va.

Volume IX **MAY-JUNE, 1929** **Number 54**

CONTENTS

		PAGE
Army Day, April 6, 1929		Frontispiece
Ordnance Supply	By Samuel Hof	377
The Importance of Military Inventions		382
Servicing Armament in the Field	By James Kirk	383
Index to Army Ordnance, Volume IX		386
William Corbit Spruance		387
The Design of Automotive Ordnance	By Alfred Fellows Masury	388
The Heavy Armored Car	By C. C. Benson	391
Novel Design of British 6-Wheel Trucks		394
Mobility of New 3-inch A. A. Guns	By John K. Christmas	395
Maintaining Our Munitions Reserves	By D. M. King	399
Gliders Used as Antiaircraft Targets		402
Corps Area Ordnance Activities	By C. T. Harris, Jr.	403
Civilian Personnel in the World War	By Charles L. Snyder	407
Semiautomatic Rifle Competition		411
Subsidized Motor Vehicles in England		412
Educational Orders for Munitions	Statement of Frederick J. Haynes	413
Henry C. Osborn, Chief, Cleveland Ordnance District		415
Preservation of Ammunition	By D. C. Hall	416
Editorial		420
Merchandising Munitions—Alexander Lewis Jenkins — A Short-Sighted Policy — Violet Rays for Guns — Things Worth Debating — The Spruance Endowment.		
Books		423

"No great nation in the world, knowing that America has prepared itself for defense, will ever venture to attack it. It is the best insurance against aggression and it is costing the people of the United States almost nothing in its preparation."
Charles B. Robbins, *Former Assistant Secretary of War.*

ARMY ORDNANCE ASSOCIATION

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

OFFICERS

Vice-President
WILLIAM W. COLEMAN
Milwaukee, Wis.

President
BENEDICT CROWELL
Cleveland, Ohio

Vice-President
WILLIAM C. SPRUANCE
Wilmington, Del.

Secretary
CHAS. R. BAXTER
Washington, D. C.

Counsel
JOHN ROSS DELAFIELD
New York, N. Y.

Treasurer
CHAS. ELLIOT WARREN
New York, N. Y.

Directors

ROBERT P. LAMONT
Chicago, Ill.

FRANK A. SCOTT
Cleveland, Ohio

C. L. HARRISON
Cincinnati, Ohio

SAMUEL McROBERTS
New York, N. Y.

CHARLES H. TENNEY
Boston, Mass.

WALDO C. BRYANT
Bridgeport, Conn.

RALPH M. DRAVO
Pittsburgh, Pa.

JOHN C. JONES
Philadelphia, Pa.

JAMES L. WALSH
New York, N. Y.

BRUCE CORNWALL
San Francisco, Calif.

SPENCER G. KUHN
Cincinnati, Ohio

HARRY SCULLIN
St. Louis, Mo.

PLINY E. HOLT
Stockton, Calif.

THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our Nation's strongest guarantee of peace.

THE Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

THE Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times coöperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace Insurance" in this form is the foremost aim of the Army Ordnance Association.

THE Association is purely patriotic; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration.

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American Scientists, Inventors, Engineers and Manufacturers in civil life and the Regular and Reserve Officers of the Army Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the Industry of the Nation and by the Officers and Civilian Employees of the Ordnance Department in the wars in which the United States has been engaged.

ARMY ORDNANCE ASSOCIATION
The Mills Building, Pennsylvania Ave. at 17th St., N. W.
Washington, D. C.

LOCAL POSTS A.O.A.

NEW YORK

(*Organized June* 15, 1921)

President: James L. Walsh. *1st Vice-President:* Samuel McRoberts. *2nd Vice-President:* William I. Westervelt. *3rd Vice-President:* H. B. Machen. *4th Vice-President:* R. D. Coombs. *Executive Committee:* The Officers and James A. Farrell, Charles Elliot Warren, E. L. Sherwood, Earl McFarland, C. E. Davies and J. M. Boyle. *Treasurer:* Charles H. Keck. *Secretary:* Philip R. Faymonville, 39 Whitehall Street, New York City.

CALIFORNIA

(*Organized October* 17, 1923)

President: Pliny E. Holt. *Vice-President:* Charles N. Black. *Directors:* D. C. Jackling, W. H. Oliver, Reese Llewellyn, J. D. Grant, Fred. Boegle, Jr., Bruce Cornwall, Theodore J. Hoover, Samuel Kahn. *Secretary:* M. L. Brett, 58 Sutter Street, San Francisco, Calif.

CHICAGO

(*Organized May* 3, 1924)

President: A. K. Hamilton. *Vice-President:* F. A. Lorenz. *Directors:* E. J. Buffington, R. P. Lamont, E. A. Russell, W. C. Young, W. R. Wright, O. H. Wurster. *Secretary and Treasurer:* W. H. Soderholm, 600 W. Jackson Boulevard, Chicago, Ill.

BOSTON

(*Organized June* 30, 1925)

President: James F. Monaghan. *Vice-President:* Walter Powers. *Directors:* G. L. Gilmore, Everett Morss, R. F. Whitelegg, George P. Slade, Paul B. Morgan, Edward F. Miller. *Treasurer:* Isaac S. Hall. *Secretary:* John G. Booton, 200 Devonshire Street, Boston, Mass.

WASHINGTON

(*Organized November* 18, 1925)

President: James A. Drain. *Vice-President:* C. G. Mettler. *Secretary-Treasurer:* L. A. Codd, 806 Mills Building, Washington, D. C.

CINCINNATI

(*Organized December* 10, 1925)

President: F. W. Hinkle. *Vice-President:* S. G. Kuhn. *Directors:* C. L. Harrison, H. L. Campbell, R. F. Taft, W. C. James, H. W. T. Collins, R. S. Barr, Charles Hake, Jr. *Treasurer:* R. S. Barr. *Secretary:* H. L. Campbell, University of Cincinnati, Cincinnati, Ohio.

PHILADELPHIA

(*Organized December* 9, 1926)

President: Philip H. Gadsden. *Vice-Presidents:* William C. Spruance, Ernest T. Trigg. *Directors:* J. W. Rawle, Charles Day, Thomas S. Gates, Charles Z. Tryon, J. L. Poultney, J. W. Robbins. *Secretary:* F. C. Shaffer, 1325 Widener Building, Philadelphia, Pa.

ST. LOUIS

(*Organized January* 18, 1927)

President: Harry Scullin. *Vice-President:* E. D. Campbell. *Directors:* J. M. Kurn, J. W. Jarboe, A. J. Davis, E. D. Nims, M. E. Singleton, W. F. Cartet, J. M. Olin, H. I. Finch. *Treasurer:* Allen May. *Secretary:* C. M. Roberts, Southwestern Bell Telephone Building, St. Louis, Mo.

PITTSBURGH

(*Organized February* 24, 1927)

President: Taylor Allderdice. *Vice-Presidents:* T. M. Girdler, J. Frank Drake. *Directors:* Ralph M. Dravo, H. A. Gidney, J. Rogers Flannery, E. T. Whiter, H. P. Davis, Frank B. Bell. *Treasurer:* G. M. Sixsmith. *Secretary:* Fred A. McMahon, 1014 Diamond Bank Building, Pittsburgh, Pa.

MILWAUKEE

(*Organized September* 26, 1928)

President: W. W. Coleman. *Vice-President:* Eric H. Lichtenberg. *Directors:* Herbert V. Kohler, William Horlick, Jr., James G. Cowling. *Secretary-Treasurer:* George H. Boyer, 2315 Michigan Street, Milwaukee, Wis.

Army Day, April 6, 1929

New York City Commemorates the Twelfth Anniversary of our Entry into the World War

AS in other cities throughout the land, New York observed Army Day with appropriate ceremonies including a military parade in which there were 7,000 marchers. There is cause for reflection always on such a commemorative occasion. On April 6, 1917, when war was forced upon us few if any real Americans doubted the necessity of our military establishment or begrudged a penny for the proper equipment of our Regular Army and the legions that were soon to follow it. But that was 12 years ago. Peace has come and with it the lazy forgetfulness born of prosperity and power. By general consent and with heartfelt gratitude Armistice Day is devoted to the memory of the heroic dead. The observance of Army Day should be educational thus serving the purpose of recalling to mind in an especial way our lack of preparedness in 1917, the value of adequate military defense in the light of experience in the World War, and the vitally important needs of the military establishment for trained reserve man power and prepared industrial munitions power.

ARMY ORDNANCE

VOL. IX MAY-JUNE, 1929 No. 54

Ordnance Supply

The System by Which the Army is Munitioned

By Samuel Hof*

THE following article has been written in an effort to present to the reader a skeletonized picture of the mechanism and procedure by means of which the tools of war are gotten into the hands of our soldiers and are kept under control. The materials discussed are those issued by the Ordnance Department and used by troops directly or indirectly for combat purposes. The primary functions are receiving, storing, shipping and issuing. Many others are involved.

Let us begin by reviewing the parts of the military establishment which are concerned in the control and accomplishment of the supply activities so that their interrelations may be clear. In Washington, the President, as Commander-in-Chief, has in his cabinet the Secretary of War.[1] To advise the Secretary and to direct the performance of the Army functions there exists the Chief of Staff. To prepare the various plans on which the Chief of Staff bases his orders to the military establishment there is the War Department General Staff. This consists of five divisions, each headed by an Assistant Chief of Staff. One of these divisions (the 4th) is charged with supply and is known as the Supply Division (G-4).

The duty of G-4 is to prepare basic supply plans from which the various supply branches can prepare detailed plans for the accomplishment of their several missions. Other duties are to prepare plans and policies and to supervise activities concerning distribution, storage and issue, transportation, traffic control, tables of equipment, the quantities and types of military supplies required for the use of the Army, time and priority of deliveries.

Among the branches of the Army are certain organizations charged with supplying its material needs. Of these the two chief supply branches for the Army at large are the Quartermaster Corps and the Ordnance Department. The Corps of Engineers, the Signal Corps, the Chemical Warfare Service and the Medical Department furnish supplies pertinent to their own departments and used to a limited extent by other branches. The Coast Artillery Corps furnishes its own submarine mine equipment and the Air Corps its own aeronautical equipment. These branches *operate* the Army system of supply.

The operations of the Ordnance Department, under the direction of the Chief of Ordnance, are controlled and administered by his office in Washington, one of the main divisions of which is Field Service. The latter office, under the Chief of Field Service, is charged with the supply, maintenance, etc., of ordnance materials; and directs the activities of its field agencies. Field Service is in turn divided and includes a General Supply Division, an Ammunition Supply Division and several others. The two mentioned, direct and regulate the distribution of supplies.

To clarify the organization down to this point the reader is referred to the chart on page 378.

HAVING disposed of the Washington organization, the agencies in the field will now be considered; first on a peace-time basis.

To house the munitions which have been procured, storage depots have been established at various points throughout the United States and in its foreign possessions. Some of these depots are initial supply points for certain commodities and make distributions to other depots. Some depots store only reserve supplies to be used in case of war. Other depots store and issue only the current supplies required by the troops whom the depot is designated to serve. Many of the depots perform all of the above functions. There can be no clear cut classification on this basis.

All depots, except those in foreign departments, are controlled directly by the Chief of Ordnance and do not belong to the Corps Areas in which they happen to be located. This is necessary because each such depot has or may have obligations beyond the limits of such area. Foreign depots are controlled by Department Commanders.

For administrative purposes the United States is divided into 9 Corps Areas; and the Canal Zone, Hawaii and the Philippines are designated Departments. Each corps area and department is commanded by a general officer with an appropriate staff. The staff includes a G-4 whose duties are similar to those, described above, of the G-4 in the War Department General Staff, but are limited in scope to the particular corps area or department. Also in the staff there is a corps area or department ordnance officer among whose duties is the administration of ordnance supply within the corps area or department.

Each area draws its ordinary supplies from designated depots conveniently located; but various depots are involved in the furnishing of all the kinds of supplies required. The corps areas do not receive supplies in bulk from depots and then distribute them to stations or troops. Issues from depots are made directly to all the various stations. The foreign departments do, however, to some

*Assistant to the Chief of Ordnance, U. S. Army, and Chief of Ordnance Field Service. Brigadier General, Ordnance Department, U. S. A.

[1]The Assistant Secretary of War is charged with "Procurement for the Army." Since this article begins where his duties end, they are not discussed here.

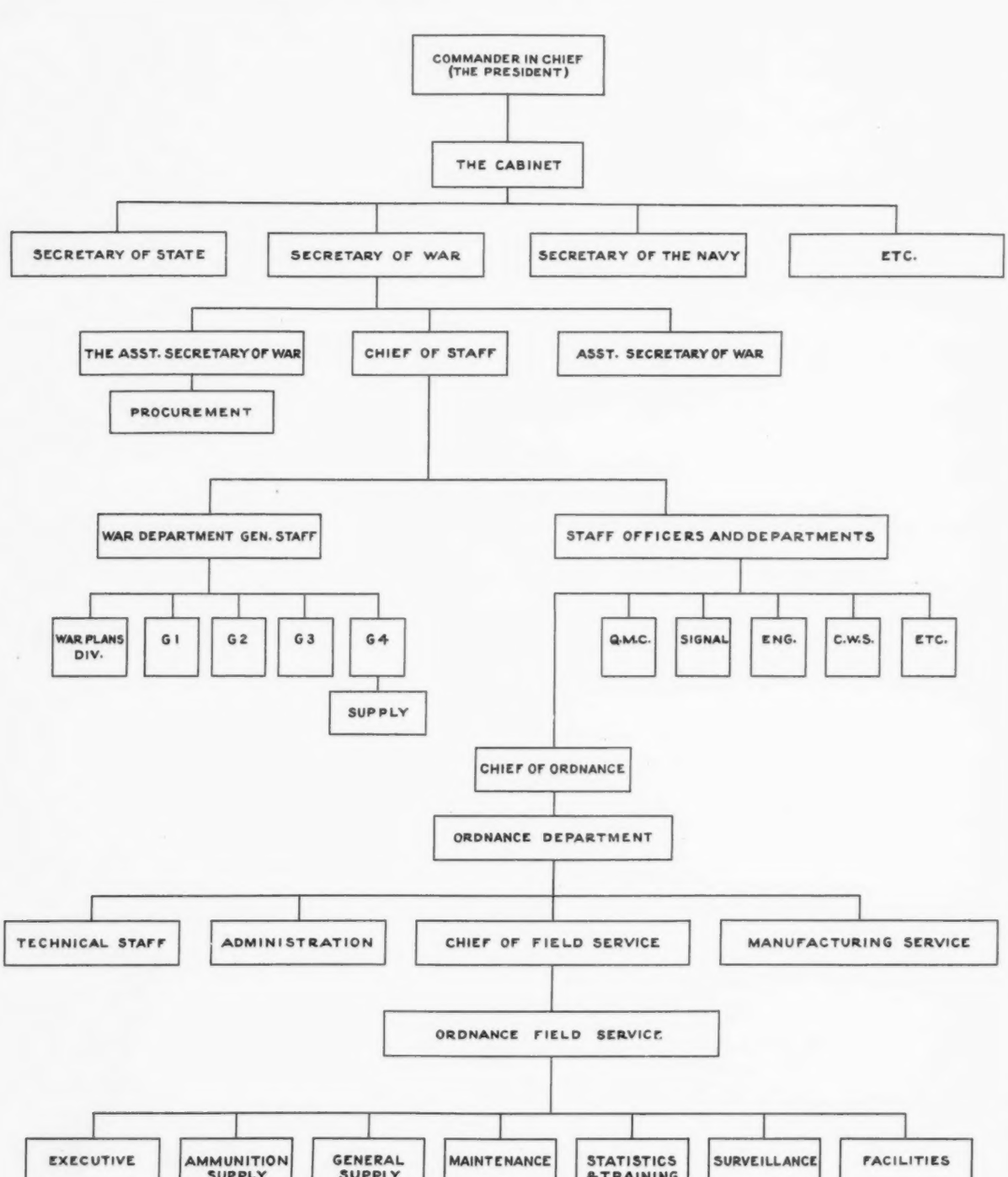
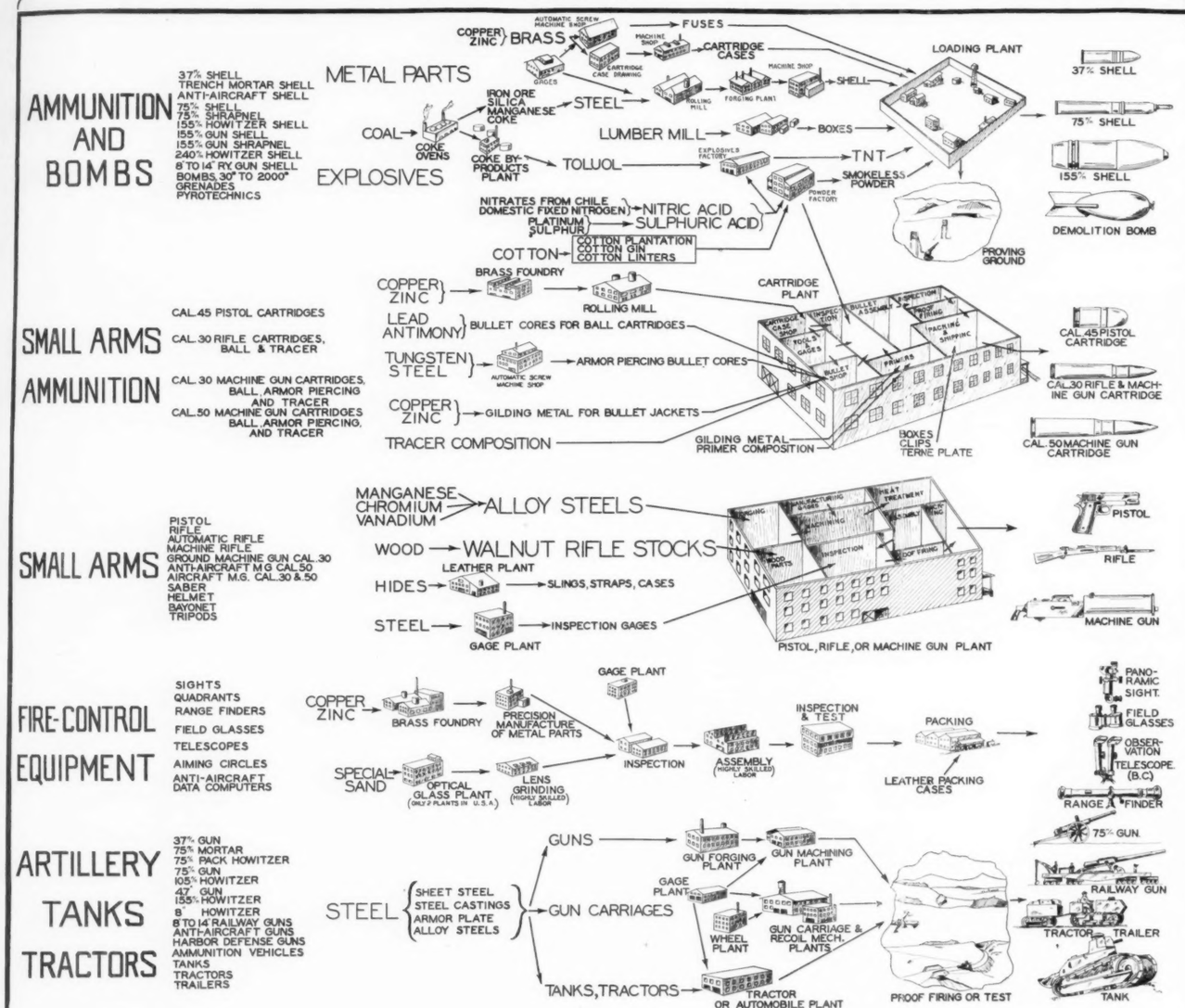


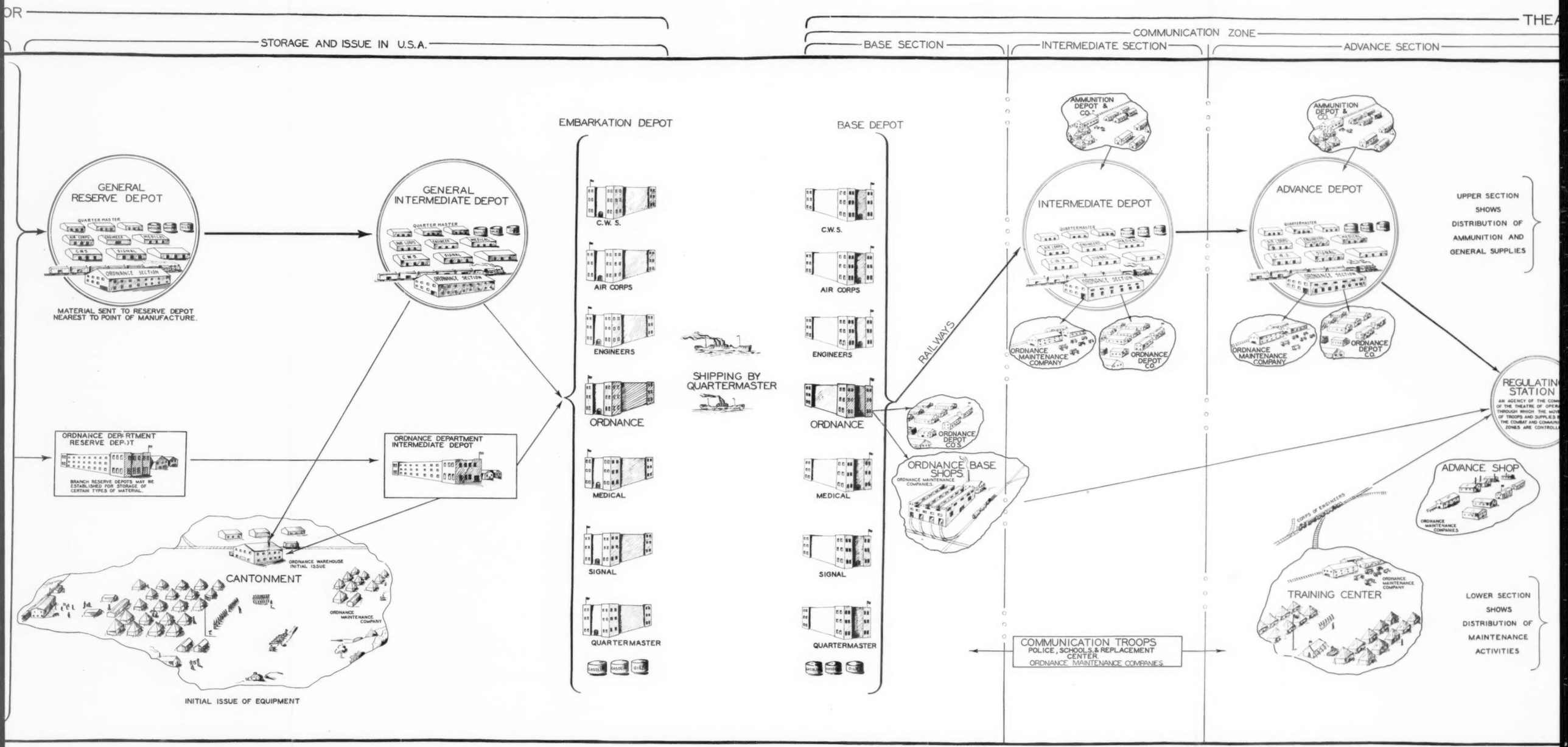
Chart Showing Principal Administrative Units in the System of Ordnance Supply.

ZONE OF INTERIOR

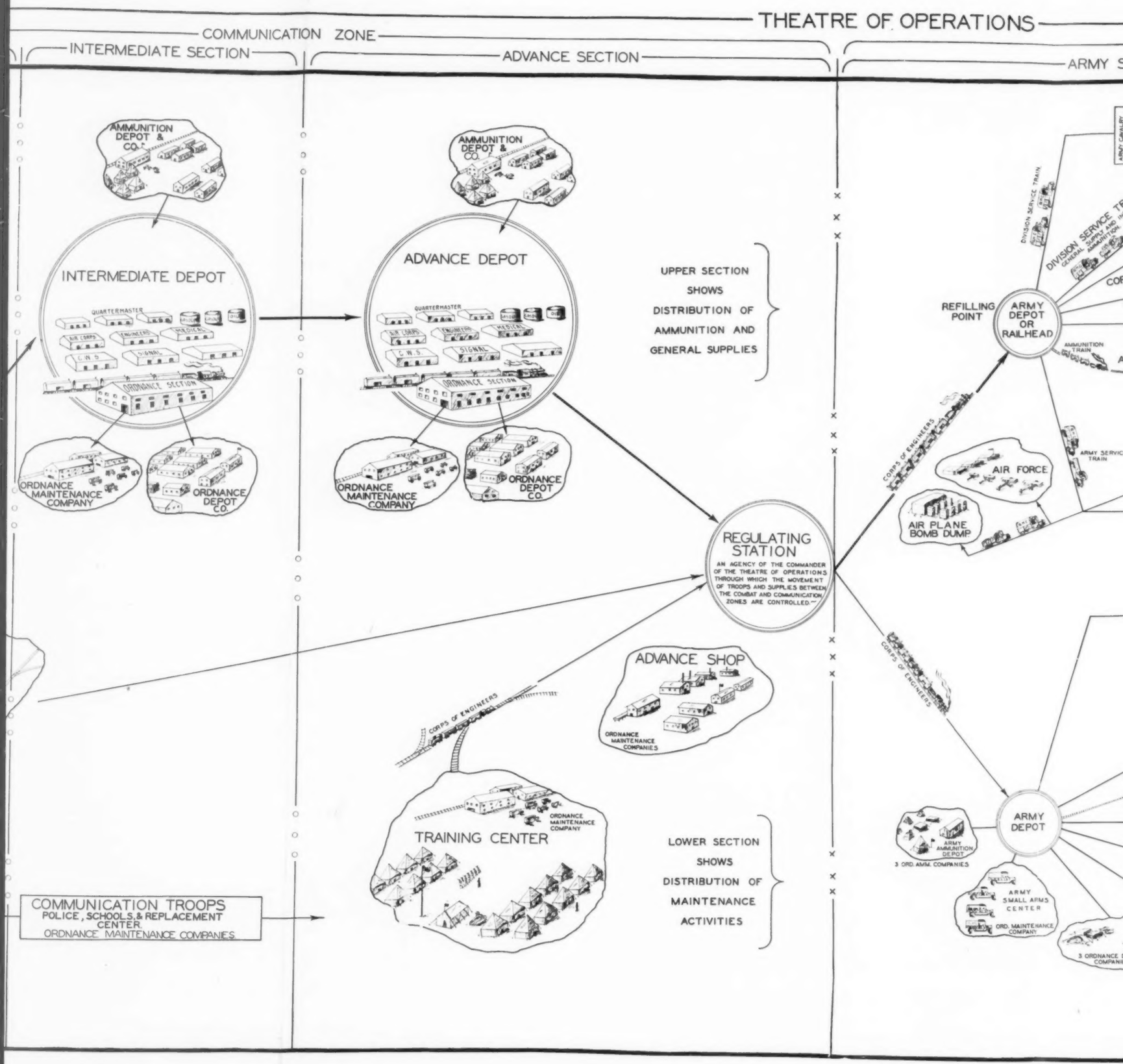
PROCUREMENT

STORAGE AND ISSUE IN U.S.A.

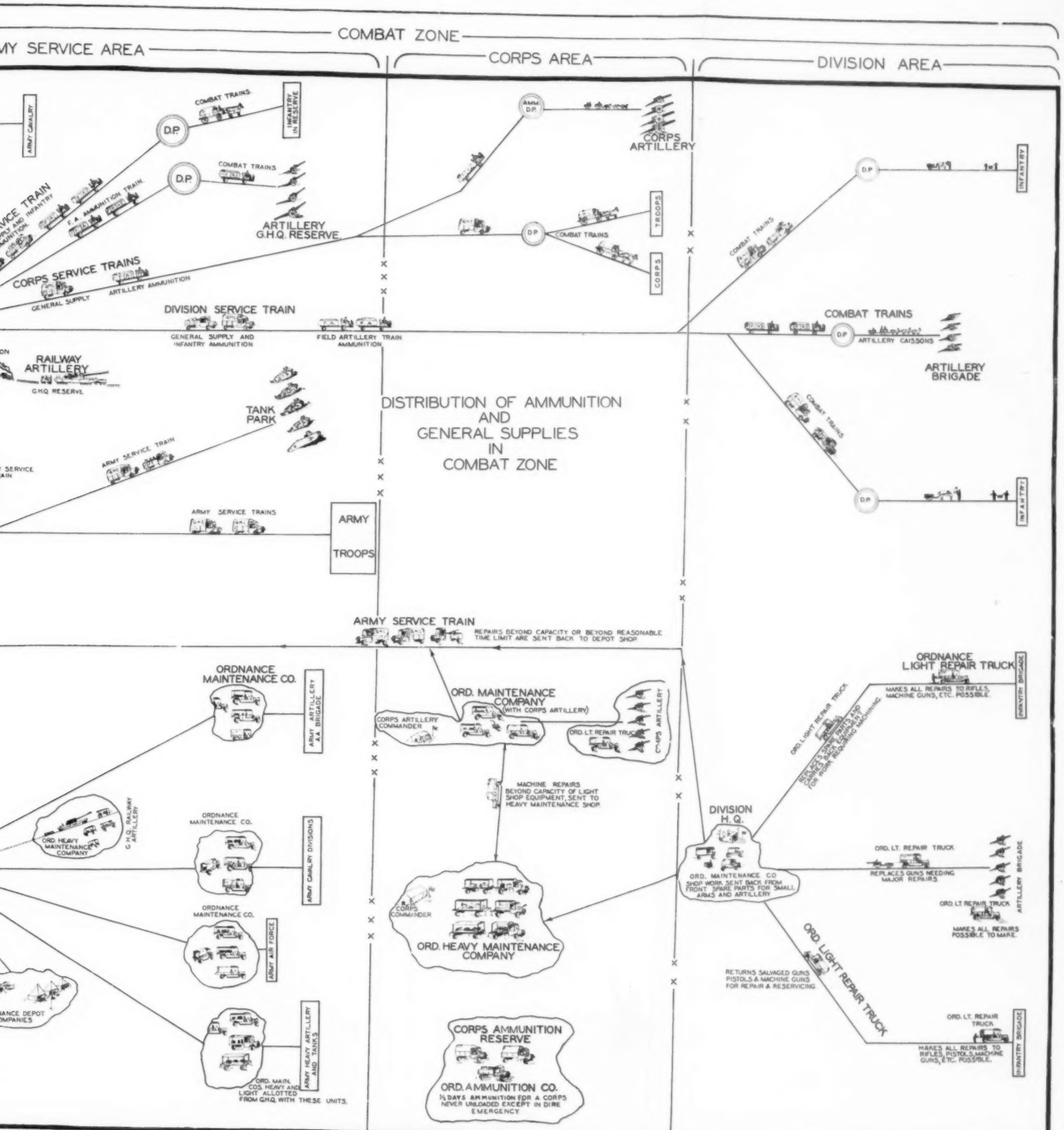




Procurement of Ordnance Munitions and Supply to Troops



ply to Troops


COMBAT ZONE
MY SERVICE AREA
CORPS AREA
DIVISION AREA
ARMY CAVALRY
COMBAT TRAINS
INFANTRY IN RESERVE
D.P.
VICE TRAIN
F.A. AMMUNITION TRAIN
ARTILLERY G.H.Q. RESERVE
CORPS SERVICE TRAINS
GENERAL SUPPLY
ARTILLERY AMMUNITION
DIVISION SERVICE TRAIN
GENERAL SUPPLY AND INFANTRY AMMUNITION
FIELD ARTILLERY TRAIN AMMUNITION
AMM. D.P.
CORPS ARTILLERY
TROOPS
CORPS
COMBAT TRAINS
INFANTRY
ARTILLERY CAISSONS
ARTILLERY BRIGADE
RAILWAY ARTILLERY
G.H.Q. RESERVE
TANK PARK
ARMY SERVICE TRAIN
ARMY SERVICE TRAINS
ARMY TROOPS
DISTRIBUTION OF AMMUNITION AND GENERAL SUPPLIES IN COMBAT ZONE
ARMY SERVICE TRAIN
REPAIRS BEYOND CAPACITY OR BEYOND REASONABLE TIME LIMIT ARE SENT BACK TO DEPOT SHOP
ORDNANCE MAINTENANCE CO.
ARMY ARTILLERY A.A. BRIGADE
ORD. MAINTENANCE COMPANY (WITH CORPS ARTILLERY)
CORPS ARTILLERY COMMANDER
ORD. L.T. REPAIR TRUCK
CORPS ARTILLERY
ORDNANCE LIGHT REPAIR TRUCK
MAKES ALL REPAIRS TO RIFLES, MACHINE GUNS, ETC. POSSIBLE.
INFANTRY BRIGADE
ORD. LIGHT REPAIR TRUCK
REPLACES SPARE PARTS AND CARRIES BACK GUNS AND E.M. FOR WORK REQUIRING MACHINING
MACHINE REPAIRS BEYOND CAPACITY OF LIGHT SHOP EQUIPMENT, SENT TO HEAVY MAINTENANCE SHOP.
ORD. HEAVY MAINTENANCE COMPANY
G.H.Q. RAILWAY ARTILLERY
ORDNANCE MAINTENANCE CO.
ARMY CAVALRY DIVISIONS
DIVISION H.Q.
ORD. MAINTENANCE CO. SHOP WORK SENT BACK FROM FRONT SPARE PARTS FOR SMALL ARMS AND ARTILLERY
ORD. L.T. REPAIR TRUCK
REPLACES GUNS NEEDING MAJOR REPAIRS
ORD. L.T. REPAIR TRUCK
MAKES ALL REPAIRS POSSIBLE TO MAKE
ARTILLERY BRIGADE
ORDNANCE MAINTENANCE CO.
ARMY AIR FORCE
CORPS COMMANDER
ORD. HEAVY MAINTENANCE COMPANY
ORD. LIGHT REPAIR TRUCK
RETURNS SALVAGED GUNS PISTOLS & MACHINE GUNS FOR REPAIR & RESERVICING
ORD. L.T. REPAIR TRUCK
MAKES ALL REPAIRS TO RIFLES, PISTOLS, MACHINE GUNS, ETC. POSSIBLE.
INFANTRY BRIGADE
ARMY HEAVY ARTILLERY AND TANKS
ORD. MAIN. COS. HEAVY AND LIGHT ALLOTTED FROM G.H.Q. WITH THESE UNITS.
CORPS AMMUNITION RESERVE
ORD. AMMUNITION CO.
½ DAYS AMMUNITION FOR A CORPS NEVER UNLOADED EXCEPT IN DIRE EMERGENCY

ARMY ORDNANCE
MAY-JUNE, 1929
VOL. IX, NO. 54

An Ordnance Building in the Great Intermediate Depot at Gievres, France, 1918. *Signal Corps Photo*

extent, draw supplies in bulk and make their own distributions.

Each Regular Army post (camp, post or station) has a post ordnance officer and an ordnance warehouse at which are received all supplies destined for any troops at that post. Here they are stored and from here they are issued to the various organizations upon request. As occasion warrants incoming supplies may go directly to troops to avoid unnecessary handling and accounting by the post ordnance officer. The principle of skipping any link in the distribution chain applies whenever requirements are satisfied and economy of effort results.

Now, let us see how the distribution of supplies is put in motion and accomplished. Remember that the War Department has prescribed what the troops may have and are entitled to expect. This has been published in equipment tables and allowance tables. Their initial equipment was sent to them by the Ordnance Department at the time they were organized;—this action being based on War Department instructions for the organization and equipment of the various units. But the troops must submit requisition for their current supplies, in accordance with published tables of allowances and for such replacement and repair parts as they may need, except for such items as may be obtained by exchange. These requisitions go to the post ordnance officer, are checked against authorized allowances and are filled by him as completely as possible from stocks on hand. Unfilled items are abstracted and included in a consolidated requisition made by the post ordnance officer and sent to the corps area ordnance officer, where it is rechecked and sent to the proper depot, for fulfillment. Any request for unauthorized supplies is forwarded through channels for action by the War Department. Action is taken in accordance with the decision made by the General Staff.

SO FAR we have presupposed that depots are adequately stocked. Now let us see how the stocks are replenished.

Unloading Ordance Supplies from Ships at a Base Depot. *Signal Corps Photo*

This brings us first to the consideration of property accounting in the depots.

For the convenience in accounting, as well as for other general purposes, supplies are classified into groups and the various groups are physically segregated in warehousing. The ammunition groups are segregated into separate depots insofar as is practicable. Stocks of ammunition are controlled by the Ammunition Supply Division in Washington and all ammunition accounts are rendered to that office. General supplies are controlled by the General Supply Division to which accounts are rendered. These two offices in Field Service keep consolidated accounts of the supplies at all depots, and from analysis of the total balances determine what replenishments are necessary. While the General Supply Division deals directly with the depots, the Maintenance Division of Field Service really controls such supplies as are involved in "maintenance"—e.g. spare parts, oils, greases, etc. The Maintenance Division prepares estimates, places procurement orders, and regulates issues of these supplies.

Some of the supplies used by Field Service are commercial and can be purchased on the market. Such purchases Field Service makes itself (acting as agent for Manufacturing Service) through the agency of one (or more) of its depots, to whom the necessary funds are transferred. Noncommercial munitions are listed in a purchase order which is passed over, together with the necessary funds, to the Manufacturing Service of the Ordnance Office for procurement. The Manufacturing Service is the procuring agency for the Ordnance Department.

BUT, whence the funds? Each year Field Service prepares detailed estimates of the requirements for the next fiscal year. These are consolidated with estimates from all other divisions in the Ordnance Office into a book of estimates which is reviewed by the War Department Advisory Committee and finally transmitted to the Director of the Bureau of the Budget. Eventually, the estimates go to Congress as a part of the National Budget. Congress appropriates what it considers proper and this money is set up on the books of the United States Treasury and made available for expenditure.

Having seen in a general way how the Regular Army is supplied, let us turn to the National Guard, the Organized Reserves, the Reserve Officers' Training Corps and Citizens' Military Training Camps.

The National Guard is administered by the Militia Bureau in Washington to which Congress appropriates money for National Guard expenses. Having money, they purchase their supplies from the Ordnance Department (except initial organization equipment which by law is issued free). Requisitions from the various units are sent to the corps area ordnance officer. He transmits them to depots where issues are made. Prices are entered on the shipping tickets and after these have been signed as receipts by the National Guard units and returned to the depot, they are sent to the Ordnance Office and then to the Militia Bureau. Upon receipt of this evidence the Bureau transfers to the Ordnance Department funds to the amount involved.

Unloading Caissons at a Corps Park. *Signal Corps Photo.*

THE Organized Reserve, under the National Defense Act, is one of the components of the Army of the United States. As such, Congress makes annual appropriations for its training and supply, and the money is suballotted to the various corps areas and departments in accordance with tactical grouping and training facilities within these territorial divisions. So far the Organized Reserve units have been established only as cadre consisting of a war-strength complement of officers and a limited number of noncommissioned officers. On the staff of the corps area or department commander is an organized reserve officer whose function it is, among others, to handle the supply of munitions to those units entitled to receive them through tables of allowance prescribed by G-4 of the War Department General Staff. Issues are made through requisitions from the unit to the corps area or department organized reserve officer, who in turn checks the requisitions and forwards them to the proper depot for supply. The signed shipping ticket acts as a voucher for reimbursement to the Ordnance Department against organized reserve funds in a manner similar to that described under the National Guard. Reserve officers undergoing summer training draw their equipment on memorandum receipt from the local

ordnance officer and turn it in upon completion of training. Both the R. O. T. C. and the C. M. T. C. are institutions prescribed by the National Defense Act for the training of our citizenry in peace time. Congress appropriates money annually for the maintenance and supply and this money is in turn suballoted to corps areas. Again we find on the staff of the corps area commander an R. O. T. C. and a C. M. T. C. officer. Tables of allowances govern the supply of munitions to each. R. O. T. C. units submit requisitions through their corps area R. O. T. C. officer who checks and forwards them to depots for supply. These units keep the equipment they use and are accountable for it. Reimbursement of funds when necessary is effected through the medium of the signed shipping ticket. The C. M. T. Camps take place each summer at designated camps. Prior to the opening of the camps the camp ordnance officer requisitions for all needed ammunition through the corps area C. M. T. C. officer and upon the opening of the camp this material is issued to the students and turned in by them upon the completion of the camp. The cost of transportation of this material to the camps, replacement of lost or damaged equipment, and the reconditioning of equipment is borne by C. M. T. C. funds upon proper voucher of the camp ordnance officer submitted to the C. M. T. C. officer.

Scene at an Ammunition Depot. *Signal Corps Photo*

The Ordnance Department sells each year a great quantity of munitions to foreign governments, to the Navy Department, the Marine Corps, the Coast Guard Service and to any individuals connected with the military establishment and to members of the National Rifle Association. According to law money received from sales of certain classes of supplies must be covered into the Treasury for general use and is a loss to the Ordnance Department. However, for most classes of supplies the money, although deposited in the Treasury, may be used to procure new supplies similar to those which were sold. Also equipment is lent to other executive departments of the government such as the Post Office, the Interior and the Treasury Departments.

NO ATTEMPT is made in this article to cover the details involved in each step of the supply procedure. Such an attempt, if made, would turn a brief outline into a voluminous text. Let us therefore proceed to consider what extension of the system becomes necessary upon the advent of war.

Assuming that the corps area commanders have been ordered to mobilize the reserves, the necessary ordnance equipment will be sent from the depots, where reserve equipment is stored, to the camps at which the troops are gathering. This action and the continued supply to new troops only expands existing activities. When armies are organized and take up a mission which requires them to move to a certain area (which for the most general cases we will assume is outside the United States) then an extension must be added to existing provisions for supply. The area in which operations are conducted is known as the theatre of operations. The part used for combat operations is called the *combat zone*. The territory next in rear is called the *communications zone;* and that part of the United States not included in the theatre of operations is the zone of the interior.

To get the supplies across the *communications zone* and to provide an uninterrupted flow, a line of supply with new depots must be established therein. These depots are designated according to their locations from rear to front as *base*, *intermediate* and *advance* depots. Munitions from the United States flow through or past them in that order and thence through a regulating station to the armies. Such depots are ordinarily general for all the army supply department, but ammunition of necessity is handled in its own series of depots separate from the others. Depots decrease in size as they approach the front so that the bulk of munitions may be kept well in hand for distribution, and so that large stocks may not be subject to possible capture.

Shipments from advance depots go to a regulating station where they are routed on to the proper army depot. Now let us see how they are handled in the combat zone.

The armies are divided into corps, the corps into divisions, and the divisions into regiments. The army depot receives munitions from the advance depot and makes distribution to the division dumps which in turn redistribute to the regiments. The corps does not ordinarily have a hand in this, but has a corps park for its own auxiliary troop and this park is supplied from the army dump. The ammunition is still separate from the other munitions—separate dumps and generally separate transportation.

The difference in *control* of munitions becomes more marked than the difference in *handling*. The extreme importance that supply be prompt and adequate requires that it be given close attention. While as much information as possible is sent from front to rear, nevertheless the burden of responsibility rests on the rear to get supplies to the front. Let us see what organizations exist in the communications and combat zones and how the control is exercised.

FOR the conduct of an extensive operation, such as we are considering, a general headquarters (G. H. Q.) would doubtless be established. This would be a limited miniature of the Washington organization, including General Staff sections and staff officers (liaison) for the supply branches;

and would likely be located in the combat zone. For the operation of the entire supply system in the communications zone there would be established another important subsidiary headquarters. This would relieve the general headquarters of the details of this work and permit concentration on the operations in the combat zone.

Due to the importance of ammunition in connection with operations full information regarding it would be kept by the ordnance liaison officer at G. H. Q. His records would be kept up-to-date based on information furnished by the Chief Ordnance Officer.

In the combat zone the supply of munitions is handled by the various ordnance officers on the staffs of the commanders of the tactical units—the G-4's on these staffs exercising their functions as previously explained. The army ordnance officer looks out for the army as a whole and keeps sufficient stocks in the army dump to meet the immediate requirements of the various components. The division ordnance officer similarly looks out for his division and receives in the division dump the supplies for distribution to the units of the division. There is no accountability for property other than that necessary to insure adequate supply. Requisitions from the units go to the division ordnance officer, are consolidated and forwared to the army ordnance officer. Shipment is then made from army depot to division dump where distribution is made to units.

While there may be little glory in the supply game, there is plenty of excitement when things are lively. It is a constant battle against circumstances and the resourceful go-getter is in his element. There is much satisfaction in putting it over.

The Importance of Military Inventions

COL. J. F. C. Fuller, C. B. E., D. S. O., *p. s. c.*, writing in a recent issue of *The Army, Navy and Air Force Gazette* (London) discusses the importance which should attach to military inventions. His remarks are so pertinent that we take the liberty of quoting the following from our distinguished contemporary:

"It is curious, though undoubted, that when warlike inventions were few, military writers took a pronounced interest in them, and when they became many, as during the last 100 years, more and more have these writers neglected to examine their value. Had a workable tank been invented in the Middle Ages the whole world would have been agog, but in 1916 such a machine was looked upon as a 'military toy,' and is still, by some, considered a doubtful weapon.

"Next to genius, inventions have played the most important part in war, and though military history proves this clearly, it is frequently overlooked and often denied. There is still a school of thought which asserts that if men are firmly led and have stout hearts, the perfection of their weapons is of quite subsidiary importance. To persuade the student that this is not so, the influence of a few of the more noted military inventions will be examined.

"Philip of Macedon, by lengthening the heavy infantry pike of his day by some six feet, produced a weapon of irresistible shock-power, namely, the *Sarissa*. It was one of several factors which made him master of Greece, and which enabled his son, Alexander the Great, to conquer the known world of his day. The *Corvus*, or crow, a spiked boarding gangway invented by the Romans (who were amateur seamen), enabled them to wrest the command of the sea from the Carthaginians, the most expert sailors of their age. Greek fire saved Christendom from the Arab and Russian hordes for several centuries. In A. D. 718 Theophanes, at the head of 15 ships fitted with Greek fire projectors, routed a Russian fleet of 1,500 vessels. Mail and plate armour, introduced during the Middle Ages, for the greater part of 1,000 years rendered infantry impotent. The invention of the bayonet, in 1670, by Vauban, greatly limited the power of the cavalry charge, the fate of which was sealed by the invention of the percussion cap in 1814, because the flintlock was a most unreliable weapon in rainy weather. The explosive shell at sea pronounced the doom of the wooden warship, for she could easily be set on fire, and the result was that ships were built of iron and then armoured with steel. After the engagement of the *Merrimac* and *Monitor*, in 1862, Sir John Hay said: 'The man who goes into action in a wooden ship is a fool, and the man who sends him there is a villain.' The introduction of the rifle, and particularly the breech-loading rifle, entirely changed infantry, artillery and cavalry tactics. E. P. Alexander, the Confederate General, says in his book, *The American Civil War:* 'There is reason to believe that had the Federal infantry been armed from the first with even the breech-loaders available in 1861 the war would have been terminated within a year.' At length we come to the invention of the machine-gun, which sealed the doom of the rifle and bayonet attack, and the result was the creation of the tank, and the reintroduction of armour in land warfare. Were Sir John Hay alive today he might well exclaim: 'The man who goes into action in a woolen shirt . . .' etc., etc.

"In the past, inventions have generally had haphazard origins. A monk of Metz discovered gunpowder. 'Surely,' says Fuller (Thomas, the divine), 'ingenuity may seem transposed, and to have crossed her hands, when about the same time a soldier found out printing.' Yet since his day how strangely has this process of discovery continued. Watt, an instrument maker, perfected the steam engine; Stephenson, first a cowherd and later on a brakeman, and who could neither read or write until he was nearly twenty, invented the first efficient locomotive, and revolutionized the civilized world. If this is not strange enough, we find that the Dunlop tire was thought out by a veterinary surgeon, and that during the last war the disintegrating areoplane machine-gun link was the creation of a dentist, and that the Stokes gun was designed by a concrete merchant. On this subject Lord Bacon writes: 'It would seem that hitherto men are rather beholden to a wild goat for surgery, or to a nightingale for music, or to the ibis for some part of physic, or to the pot-lid that flew open for artillery, or generally to chance, or anything else than to logic for the invention of the Arts and Sciences.' In military history it certainly does seem so."

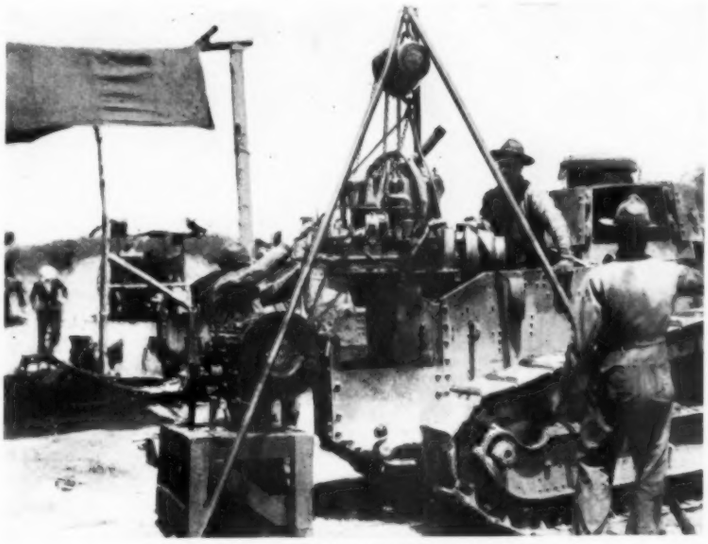
Servicing Armament in the Field

The Maintenance Functions of Ordnance Field Service

By James Kirk*

MAINTENANCE is one of the three major functions of Ordnance Field Service. The Maintenance Division in the Office of the Chief of Ordnance is the clearing house for all matters relating to the maintenance in service, preservation in storage, and modification of all ordnance supplies for issue in peace or war.

The methods of procedure are outlined in technical regulations, field service bulletins, modification work orders, and letters of instruction prepared in the Ordnance Office. Funds required are estimated for and distributed in accordance with requirements. Decisions are rendered on technical matters. Difficulties reported are studied and solutions sought. Inspections are made at varying intervals to obtain first-hand knowledge of conditions and problems existing in the field and at ordnance establishments. The Maintenance Division is an agency of assistance for all ordnance officers in the field, and free discussion of all matters under its jurisdiction is encouraged. As an element of the Office of the Chief of Ordnance, the right of final decision is of course reserved, but a friendly rather than a dictatorial policy is advocated.



Repairing a 6-ton Tank in the Field.

Control of the execution of the work of the Maintenance Division is decentralized. The condition of ordnance supplies in a given corps area or department is a responsibility of the corps area or department commander. "It is a fundamental principle of command that the commander of any military organization is in full control of all personnel assigned thereto, and is alone responsible to higher authority for the results obtained by his organization.

In accordance with this principle, the ordnance officer, although charged with certain duties and functions which apply to the unit as a whole, must remember that these duties and functions are primarily the responsibility of unit commanders, and any directions or instructions issued subordinate units must be transmitted through the proper channels of command, and not directly from one special staff officer to the corresponding special staff officer in a subordinate unit."

"The duties of the ordnance officer are:

(1) Command, in so far as relates to operations of Ordnance troops not assigned or attached to subordinate units.

(2) Adviser to the commander and the staff in ordnance matters.

(3) Supply of ammunition and other ordnance equipment and supplies.

(4) Operation of ordnance storage, maintenance, and repair facilities, including salvage and repair of ordnance matériel.

(5) Technical inspection of ordnance equipment.

(6) Supervision, within limits prescribed by his commander, of ordnance activities in subordinate units.

(7) The collection of information concerning ordnance matériel."

As a means for the execution of his duties, the corps area ordnance officer is provided with certain assistants. These generally include one or more junior officers, an armament foreman, several armament machinists, repairmen, and a small clerical force to take care of records and correspondence. Each post within the corps area has an ordnance officer or acting ordnance officer in charge of local activities. At the larger posts, ordnance maintenance companies are provided to perform mechanical repairs within the scope of their equipment. This equipment is generally more elaborate than that of the mobile shop and is installed in a permanent building. To insure a training nucleus for the enlisted personnel which is subject to frequent turnover, and to provide highly skilled mechanics, the force of each post ordnance shop is augmented by several qualified civilian mechanics. Direct contact with the using services and frequent inspections of matériel under actual conditions of performance greatly facilitate maintenance. Periodical overhaul of matériel is undertaken and direct exchange of serviceable for damaged matériel through the medium of the shop, makes prompt repair possible without interruption of the training of the using services and with greater economy than would result if the majority of mechanical repairs involved shipment to arsenals with attendant transportation charges.

Matériel in the hands of the National Guard, C. M. T. C., R. O. T. C., and Organized Reserves is inspected under the

*Chief, Maintenance Division, Field Service, Office of the Chief of Ordnance, Washington, D. C. Major, Ordnance Department, U. S. Army.

supervision of the corps area. Repairmen are present at these inspections and much repair work is done on the spot, resulting in considerable saving over the cost of individual shipments to arsenals for each item requiring repair.

At times major repairs are required, such as the overhaul of optical instruments, the relining of guns, etc., which necessitate more complete facilities than can be provided for in the field. Such repairs require shipment to a fully equipped arsenal. The arsenals performing certain classes of repair work for the different corps areas are designated in field service bulletins. As a general rule, immediate replacement of the damaged article from stock is made by the arsenal so that the using service may not be inconvenienced.

An Ordnance Company (Heavy Maintenance) at Work in the Field.

The equipment in the hands of troops forms only a part of the ordnance war reserve. At the various arsenals under the direct control of the Chief of Ordnance are stored large quantities of ordnance supplies. The care of these supplies is a responsibility of the arsenal commander. Standard methods of procedure, including periodical inspections, are required. As the amount of funds appropriated is never sufficient to meet all requirements, an endeavor is made to secure an equitable distribution of existing funds, based on the relative importance of the work involved.

THE organization of maintenance activities in time of peace is capable of adaptation to the requirements of war. The arsenal facilities will be available and the small force trained in maintenance activities in time of peace will form the backbone for an enlarged organization. The various post shops will offer valuable training and repair centers for maintenance during the mobilization and training period. Use can be made of these shops in the issue of matériel during the mobilization period. Matériel in storage at ordnance establishments can be issued to stations having permanent shops without the delay and congestion incident to reconditioning at the storage point. Prior to issue to the troops, the matériel can be reconditioned and put in serviceable operating condition by the post shop. The ordnance maintenance companies with their mobile equipment will be immediately available for assignment in the theatre of operations.

The most important users of ordnance matériel are combatant troops. As such they are in duty bound to bear a large part of the burden of the care of the weapons and other ordnance with which they are armed. Ordinary care necessary for preservation must be exercised up to the point where such care becomes impossible in actual combat. Ability to fire is of no value to the individual or organization if weapons have been rendered inaccurate by neglect. Guns can not be hauled into position or tanks brought forward if automotive vehicles can not operate. Thus, the first phase of maintenance falls on line troops.

Minor adjustments and repairs involving the replacement of simpler parts can be handled by the personnel of line troops. However, the primary function of such troops is combat, and when the time element involved in repair would result in depletion of available combatants, a point has been reached when the damaged equipment should be withdrawn for repair under more favorable conditions and replaced by serviceable matériel. The time element is dependent not only on the amount of labor required but also on the skill of the workers, their facilities, and the conditions under which the work is done. In garrison, line troops make many repairs which it would be totally impracticable for them to handle under the severe conditions imposed during a campaign. It would also be unreasonable to impose the burden of carrying numerous spare parts and tools upon a combatant organization. In former days of slow transportation it was necessary for each organization to be largely self supporting. This is no longer true for "the radius of operation within reasonable accessibility to supply centers has been greatly increased by the speed of motor transportation as compared with horsedrawn vehicles." The necessity for carrying large quantities of supplies within the combatant organization no longer exists. Failures of and accidents to parts which require replacement or repair are sporadic in nature. To guard against every possible contingency a battery or company would have to carry an imposing supply of spare parts, many of which would never be used. It is a sound principle, resulting in a requirement for fewer parts, a saving in the number of men required for repair work, and an assurance that repair work will be properly done, to have a small nucleus of specialists on repair work grouped some distance to the rear and provided with adequate facilities and a suitably diversified collection of spare parts. Such a group can serve a large number of units. Its location is fixed for an appreciable period of time and contact and accessibility definitely insured.

THE normal division organization includes a medium maintenance company, composed of 7 officers and 105

enlisted men. This company is divided into sections as follows:

A—A headquarters and supply section.—Handles the administrative work of the company, and ordnance supplies for emergency issue when required and for use in the repair work performed by other sections of the company.

B—A service section.—Handles the mechanical features common to all groups, such as welding, machining and toolmaking.

Ordnance Maintenance Company for an Infantry Division.

C—A small arms repair section.—Handles the repair of infantry weapons and equipment.

D—An automotive section.—Repairs automotive equipment.

E—An artillery section.—Handles repairs to artillery matériel other than automotive equipment.

For the transportation of the tools and other supplies certain vehicles are provided. These include: 4 light repair trucks—these allow the rapid dispatch of mechanics with kits of tools to render aid to units in position; 2 light machine shop trucks—these are equipped with a small lathe, a drill press, bench grinder, air riveting outfits, portable electric drills, autogenous welding outfit and bench cabinets provided with drawers filled with an excellent outlay of hand tools; 8 spare parts trucks—these carry the basic spare parts sets required for the service of the troops with which serving. Several auxiliary vehicles, such as cargo trucks, kitchen trailer, gasoline truck and cross country cars.

The organization is such that detachments for special purposes are readily effected. Some doctrines advocate detachment to regiments as a matter of course, but it is believed that more efficient service can be rendered if the company with its equipment is kept together. Numerous specialties are involved and any split up means a lessening of the scope of activities of the remaining elements. However, frequent inspection trips, by officers accompanied by one or two mechanics, to the organizations served, are necessary to maintain contact and first hand knowledge of existing conditions. Different situations during a campaign require separate solutions as to the method to be employed in making these inspections. In the case of the artillery, it is often desirable to detach one or more mechanics to remain with the regiments.

Informal requests or information gained by inspection are sufficient to warrant the issue of supplies. Individual judgment must be employed to check an apparent wastage.

It is the duty of the maintenance company always to keep on hand an adequate supply of spare parts and an emergency supply of replacement weapons. Replenishment is secured by sending to the rear to the depot in the army service area. Heretofore, the ordnance maintenance company with the division has been an isolated unit. Its functions would be more efficiently conducted if it were included in a battalion organization, composed of all ordnance troops with the division, under the command of the division ordnance officer.

A TYPICAL corps organization consists of three infantry divisions and certain auxiliary troops known as corps troops. There are provided with "corps troops" one medium maintenance company for the corps artillery and one heavy maintenance company. It has been proposed that the heavy maintenance company be replaced by a medium maintenance company. The equipment of the latter company is considered more suitable for corps work. If this change is made, the heavy maintenance company would be placed under the control of the army ordnance officer in the army service area. For greater efficiency in administration it is proposed to organize all ordnance units serving corps troops into one ordnance regiment, army corps. Special units detached from G. H. Q. and army will have appropriate ordnance companies attached.

The transfer of the ordnance company (heavy maintenance) from the corps to the army places this heavy shop equipment, and corresponding depot facilities, under the direct supervision of the army ordnance officer, which is more logical than a location in the corps. The army shops are territorial in nature and seldom move, while those of the corps must be ready to move at any time, as the corps is essentially a tactical organization.

The organization of the ordnance heavy maintenance company is similar to that of the medium ordnance company, but on a larger scale. It is composed of 10 officers and 288 enlisted men.

The vehicles provided for the transportation of tools and supplies include: 4 trucks, light repair; 4 trucks, light machine shop; 1 trailer, generator; 1 truck, air compressor; 1 trailer, lathe; 1 trailer, drill press; 1 trailer, milling machine; 4 trucks, small arms repair; 3 trucks, tool room; 1 truck, office and headquarters equipment; 32 trucks, spare parts. Auxiliary vehicles such as cargo trucks, cross-country cars, etc.

AN ARMY may be assumed to consist of three corps with certain auxiliary troops called army troops. Army troops are assumed to include an antiaircraft artillery brigade, an attack wing of air troops, and three cavalry divisions. One medium maintenance company should be attached to each.

It is proposed to organize army ordnance service, not including the companies attached to special units of army troops, into an army ordnance brigade, composed of a brigade headquarters and headquarters company, and two regiments, one for maintenance and one for ammunition.

The ordnance company (medium maintenance) and ordnance company (depot) furnish the necessary personnel and facilities for the operation of the small arms center. The addition of the heavy maintenance company to the army from the corps provides adequate depot facilities for the handling of parts and general supplies and for backing up the maintenance activities of the corps and division.

As to the general headquarters functions for an army or a group of several armies, the G. H. Q. reserve comprises, organically, those troops which are not habitually required by the army. It has for distribution or for direct operation a large quantity of motorized and railway artillery, tanks and airplanes.

To provide adequate maintenance of the G. H. Q. field artillery brigades, there should be in G. H. Q. reserve three ordnance maintenance regiments. One G. H. Q. ordnance maintenance regiment would include a regimental headquarters and two battalions, each battalion composed of one ordnance company (heavy maintenance) and four ordnance companies (medium maintenance).

Assignments to G. H. Q. artillery should be accompanied by appropriate assignments of G. H. Q. ordnance units. The ordnance units should go under the control of the ordnance officer of the tactical unit to which the artillery is attached.

There should be one medium maintenance company for each heavier-than-air wing. This would provide six companies for each air division. The six maintenance companies should be organized into a regiment with two battalions of three companies each. It is not expected that these companies will be directly attached to wings. They will normally establish sector repair shops. At times they may join repair shops in the zones of communication or army areas to reinforce the local shop so that they will be able to serve the organizations in their sector.

It may be assumed that the railway artillery will be operated from centers which will be equipped to handle major repairs. The radius of operation from a center will be such that for any medium repair work not requiring the withdrawal of the mounts to a shop they can be reached by a mobile repair truck within a reasonable time. One ordnance company (medium maintenance) should be provided for each regiment of railway artillery. These companies should be kept at the shop at the railroad center and provided with sufficient automotive transportation to send out skilled repair gangs with proper tools and parts when needed.

The necessity of an ordnance company (heavy maintenance) to serve each tank group for major repairs, is self-evident. There should be organized for the G. H. Q. tanks an ordnance regiment, heavy maintenance, consisting of three battalions of two ordnance companies (heavy maintenance) each, to supply the required tank maintenance.

When a tank group is attached to an army, an ordnance company (heavy maintenance) of the G. H. Q. reserve should also be attached to the army, under the army ordnance officer, to care for the maintenance of the group, as a group; and when tank units are sent forward for combat service the ordnance shop will operate as an individual shop in the army area, or support, with appropriate sections, the existing heavy shops.

When a tank group is operating with a division, maintenance requirements beyond the facilities of the tank maintenance company (repairs that can be made with hand tools only), should become a responsibility of the division ordnance service, when necessary going to the ordnance company (heavy maintenance) in the army area. When required by the situation, sections of heavy maintenance companies may be sent forward to reinforce the divisional shops.

Ordnance maintenance regiments should be provided to man the shops at the bases in the zones of communication. These regiments should consist of two battalions, each of which should contain one company (heavy maintenance), and four companies (medium maintenance). One regiment is an appropriate initial assignment to a base shop and one battalion is an appropriate initial assignment to an advance shop. Where fixed shops, with installed equipment are available, the shop equipment pertaining to the organizations should be omitted.

Prior to the World War the weapons and transport vehicles of an army were of such simplicity that very limited repair facilities were required. Each company or battery carried its own assortment of spare parts and tools and practically all repairs were made by the organization personnel. In step with the mechanical advance of industry, the mechanical devices of war have developed at a remarkable rate. This development has been accompanied by increased intricacy of design and complexity of construction. In future wars it will be of paramount importance to provide extended facilities for the repair of the equipment of a mechanized army.

Index to Army Ordnance, Volume IX.

THE present issue of ARMY ORDNANCE *completes Volume IX. An index to Volume IX, arranged alphabetically by subject and author, including title page for binding, is now available for members and subscribers and may be obtained without cost from the editorial office of* ARMY ORDNANCE. *Readers who are having the journal bound for permanent record will want the index and cover page for this purpose. Requests for copies will be handled promptly and should be addressed to: The Editorial Office, Army Ordnance Association, Mills Building, Washington, D. C.*

William Corbit Spruance

Donor of Princeton University Membership Endowment to the Army Ordnance Association

THAT a nucleus of the faculty and students of the Engineering School of Princeton University may become more closely identified with industrial preparedness activities through membership in the Army Ordnance Association, Colonel Spruance has presented an endowment to the Association under the terms of which five members of the faculty of the school, including the dean, and five members of the senior class will become full and student members, respectively, of the Association. Faculty members and students will be nominated by the dean at the beginning of each scholastic year. The fund presented by Colonel Spruance will remain intact, the yearly income therefrom being more than sufficient for the annual membership dues.

Colonel Spruance is a vice-president of the Association, a distinguished alumnus of Princeton, an engineer of national repute and an ardent advocate of industrial preparedness. He was awarded the Distinguished Service Medal for his exceptionally meritorious work with the Ordnance Department during the World War as chief of the Explosives and Loading Division. He is also the first life member of the Association.

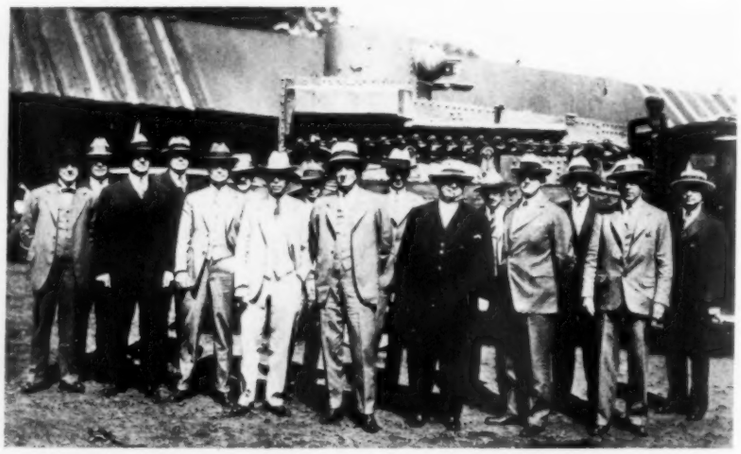
The Design of Automotive Ordnance

Functions of the Ordnance Advisory Committee, S. A. E.

By Alfred Fellows Masury*

IT has been the writer's pleasure for several years past to be connected intimately with the Ordnance Department in its automotive development work. It is believed of possible interest to the readers of ARMY ORDNANCE to give briefly the impressions gathered by me as an engineer of the commercial automotive industry.

In 1919 Maj. Gen. C. C. Williams, Chief of Ordnance, requested the Society of Automotive Engineers to appoint a committee to meet with the personnel of the Ordnance Department engaged in automotive development. Since that date biannual meetings have been held for the consideration of all projects in hand.



Ordnance Advisory Committee, Society of Automotive Engineers, with Members of the War Department Mechanization Committee.

The organization of the Office of the Chief of Ordnance appears to be one particularly well adapted to carrying out automotive development work in a manner to meet most nearly the requirements of the operating branches of the Army. There is organized in his office an Ordnance Committee, which numbers among its personnel officers of each branch of the Army. These officers present to the Ordnance Committee the broad general specifications setting forth the military requirements of any particular vehicle and are there for the purpose of presenting the views of their respective branches. The specifications are studied by the committee and as finally drawn must receive the written approval of the officers representing the interested services. The organization further provides that the specifications must then receive the approval of the General Staff of the Army. After such approval has been granted, the specifications are turned over to the Manufacturing and Design office of the Chief of Ordnance and layout studies are made to incorporate the specifications. These design studies must then be submitted to the Ordnance Committee for final approval.

The Manufacturing Service then calls a meeting of the Ordnance Advisory Committee of the Society of Automotive Engineers, on which the writer is now serving as chairman, and submits the design to this committee for its criticisms. The members of the committee are engineers actively engaged in the commercial field, and the combined talent covers a wide range of automotive experience. It has been my observation that the engineers of the Ordnance Department invariably have invited criticism and have been most willing to avail themselves of the latest thought and developments which have been brought to their attention. Many of the designs represent a well-considered compromise between the views of the Ordnance Department engineers which are based on the requirements of the using branches of the Army and those of the Society's committee.

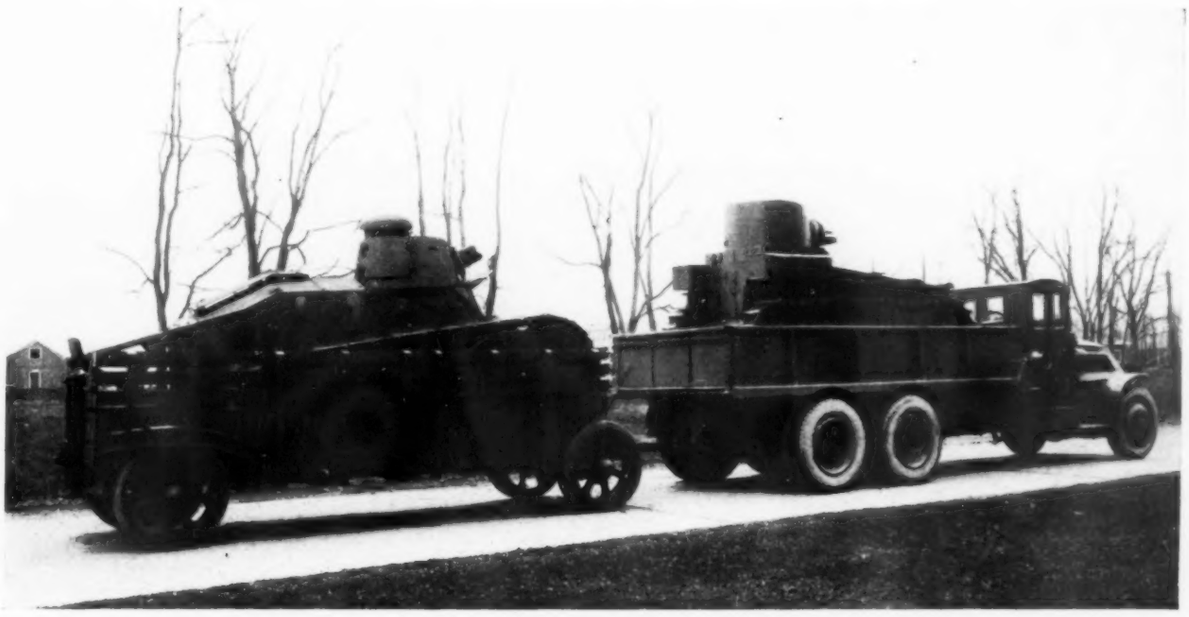
ALL design is, of necessity, a compromise between the mechanical construction and the requirements of the user. These requirements are often diametrically opposed, and the engineer and the user should, therefore, thoroughly appreciate each other's problem. The battle cruiser is a compromise between speed and armor protection in which, speed being held as paramount, the thickness and weight of armor is held to a minimum. The destroyer with its high speed requirement affords little or no protection to its personnel through armor. The battleship with its relatively slow speed carries, as being of more importance, very heavy armor protection. The fighting airplane, the chief requirement of which is speed, sacrifices many of the features demanded in commercial planes. And so it is in the case of tank design. In a tank of a given weight and high speed, armor thickness and space within the fighting compartment must be sacrificed. In designs which incorporate heavy armor plate, speed, in turn, must be sacrificed for a given weight. It is most essential that the officers of the using services appreciate and fully understand these facts.

The officers of the Ordnance Department and the ordnance engineers have, of course, been fully informed by the using services as to the military requirements of the particular vehicle. These requirements have always rightly been held as of paramount importance in controlling the design. It would seem that the first and primary requirement of any vehicle intended for combat purposes in war should be reliability, and in this regard the committee has been able to assist materially the ordnance engineers. In my opinion the Ordnance Department and the Army is particularly fortunate in having had in its employ for so many years an automotive engineer of national reputation—Mr. Harry

*Vice-President and Chief Engineer, International Motor Company. Chairman, Ordnance Advisory Committee, Society of Automotive Engineers.

A. Knox. His assistants, with whom the writer has frequently come in contact, are also men of standing and ability in the profession.

Engineers in the commercial world often find that their product does not best meet the requirements of the customer, largely due to the cu-tomer's inability to visualize his requirements and the vehicle to meet them, until after the machine has been built. The War Department evidently recognizes this fact by detailing to the Ordnance Committee officers of the using services of great experience and high ability. These officers have also available the advice of the chiefs of their respective branches and of their various service testing boards.



The Mack 8-ton 6-wheeler Carrying the Light Tank T1 E1 and Towing a 10-ton Trailer with the 6-ton Tank.

THE Advisory Committee has followed particularly closely the development of the light tank, and it is the writer's belief that the design is fundamentally sound in its effort to secure the most stable of the movable type of gun firing platform. The type of track suspension employed, known as the link type, is particularly well adapted for use with a fighting tank. The absence of springs eliminates the highly objectionable rebound of a spring suspension, and thus enormously increases the accurary of gun fire from the moving vehicle. The commercial Cunningham engine employed as motive power gives high speed and satisfactory hill-climbing ability. The arrangement of the power units within the vehicle, that is, with the engine in the front, results in so distributing the weight that the center of gravity is in the approximate longitudinal center of the vehicle. This last is, of course, necessary in a vehicle which operates on steep grades and side slopes. Any other arrangement of units must, perforce, cause the center of gravity to be moved far towards the rear of the tank. The combination of the 1-pdr. (37-mm.) gun and the machine gun in a single mount represents a great step forward in increase of fire power. The transmission and other units of the tank are rugged and have resulted in a high degree of dependable performance. The weight of the vehicle has been held to a minimum consistent with reliability, and the tank can be transported on commercial trucks at a relatively high road speed. The direction of air flow is unique and results in a cool interior of the tank. The location of the gun trunnions at the longitudinal center of the vehicle results in the maximum of fire accuracy.

As I recall, the Ordnance engineers presented two designs for this light tank to the Advisory Committee in September, 1926. It was the unanimous opinion of the committee that the design which has since been produced was by far the better one of the two; the other design showed the engine in the rear of the tank. In August of the year following the design had been completed and the pilot chassis was in operation. The writer followed the test of this vehicle with much satisfaction, and indeed so successful was the test, that the War Department in the winter of 1927-28 built four more of these fighting tanks, and two cargo-carrying vehicles employing the same chassis.

These vehicles were subjected to an exhaustive test by the Tank Services and by the Ordnance Proving Ground, during the summer and fall of 1928. One of the light tanks was subjected to a 2,000 mile test, which was completed in 57 calendar days, and in which the average speed maintained was 12½ miles per hour. At the end of this test the tank was given a complete and major overhauling. Records of operation of the Renault Tank show that it required a major overhaul at the end of 70 miles, after operation at an average speed of 1.3 miles per hour. To engineers in the commercial industry, who know that the average speed of a commercial track-laying tractor is at a maximum three miles per hour, the performance of the light tank is recognized as being exceptionally fine. It reflects great credit upon those of the Ordnance Department who were instrumental in its development. Based upon these tests certain modifications in details of design

were made and the Advisory Committee is looking forward with anticipation to the completion of another tank, which is now being built, which incorporates these modifications. This development has been carried on so expeditiously, and at such a very reasonable expenditure, that the Advisory Committee feels great satisfaction in having been connected with the work. We have the full assurance that our Army has now available a highly reliable, effective and high speed light fighting tank should the necessity arise for its quantity production. Of course, as in all lines of mechanical endeavor, improvements will be made from time to time in the vehicle in an effort to keep it fully abreast of the automotive art.

The Mack 8-ton, 6-wheeler Carrying the Light Tank T 1 E1.

IN all development work, whether it be commercial or military, it is of the greatest importance to first formulate a definite line of procedure. This should not be departed from except where absolutely necessary. The engineer must be given his requirements and must then be let alone so that he may create in steel a vehicle which will fulfill the requirements. Frequent changes of policy and specifications are not only costly in money and time, but also invariably serve to instill doubt in the minds of the engineer as to the stability of judgment of those in authority who have set up the specifications. It follows from this, that when a vehicle has been developed which is admittedly far in advance of its predecessor it should be set up as a standard. As new developments occur in the automotive art, the vehicle should be modified to meet changed conditions. By such a course the engineer is ever alert to improve his product and is fortified with the knowledge that he is working on a tangible and standardized vehicle. The many refinements found in the commercial vehicle of today are developments undreamed of ten years ago, but none the less, they have been applied to a standardized type of chassis, which, in its fundamentals, has changed but relatively little.

Automotive engineering has become a highly specialized art, and experience plays no small part in the perfection of the present-day automotive vehicles. Millions of motor cars, trucks and buses have been built within the past thirty years, and the present-day product owes its place almost entirely to that great past production. When these facts are considered the success of the light tank is even more noteworthy, since there is but little mechanical production history back of the tank. Relatively few were built during the World War and our War Department has produced a most limited number since that time. The layman is often prone to criticise the work of the specialist, in his failure to appreciate the many angles of any particular design problem. It is, after all, another case of, "A little knowledge is a dangerous thing."

A DEVELOPMENT in which the Ordnance Department has expended a great deal of time and money is that represented by the combined wheeled and track-laying type. The Advisory Committee has been particularly interested in this development as it represents a most attractive and alluring ideal. Unfortunately, compromise in design often presents insuperable difficulties in the attainment of the paramount requirement of war vehicles—dependability of performance. It still remains difficult to find a horse combining within itself qualities which make him a satisfactory field artillery draft animal today, and tomorrow, an officer's charger. He can be either one or the other, but not both. The wheeled vehicle has no peer within its realm of operation—the road; the same may be said of the track machine within its realm—cross-country. Satisfactorily to combine within one vehicle these two qualities would appear to be insuperable at the present writing.

The world, in its effort to increase the output of the individual worker, finds itself in the age of mechanization. The Army is faced with exactly the parallel situation, that is, to increase the productivity, or fire power, of the individual soldier. This can only be done by the introduction of mechanization in its various forms into the organization of the Army. In my opinion, the automotive development is proceeding along fundamentally sound lines of design.

The Heavy Armored Car

The Author's Views on the Required Characteristics of Design

By C. C. Benson*

THE business of designing fighting machines for ground troops has received far more attention from automotive engineers than from those who use the machines. Unfortunately, the engineers are not fully conversant with the needs of the troops, and are prone to over-emphasize mechanical features. As a result, we find machines that are mechanically correct in which the driver cannot see and the gunner cannot shoot. Mechanical perfection is of little use if the completed machine lacks fighting ability; hence, there is need in the design of fighting machines to shift the emphasis from mechanical to tactical features. To illustrate the application of this idea to a specific problem, the author presents herewith his views on the design of a heavy armored car.

THE heavy armored car will be used by all arms for important reconnaissance work. In addition, it will be extensively employed to attack ground troops, and to give protection against aircraft and against armored vehicles. It must provide mobility, fire power, and protection for the crew. If it can have crushing power as well, so much the better, as it will have frequent need to overcome obstacles that would otherwise block its operations. To be sufficiently mobile, the machine must be capable of sustained high speed on the road and across country. Cross-country ability is especially important, because the machine will be of comparatively little use if confined to the roads. Fire power implies weapons for use against ground troops, aircraft, armored cars and tanks. Protection for the crew, in so far as protection is possible, requires speed, armor, and suitably protected eye slits. Armor of sufficient thickness to withstand even the fire of caliber .50 machine guns, will weigh more than an agile machine can carry: hence, speed enough to avoid or escape from hostile fire will be of great importance. A vehicle that embodies these characteristics will be necessarily a non-commercial product —a special machine in the same sense that attack and pursuit planes are special. No commercial machine now being built can meet the demands that will be made on a heavy armored car.

There are four main factors to consider: running gear, power plant, driver, and gunners. For the present, we shall consider only the arrangement of these elements with respect to each other. As the running gear must rest upon the ground, its position will give no trouble. The members of the crew should be together, either forward or aft of the engine compartment, because they must coöperate continuously. If the engine is forward, as in some of the pioneer tanks, it may obstruct the driver's view; furthermore, its heat and fumes will nauseate the crew. The engine can do its work efficiently whether forward or aft, consequently it should be aft where it will not interfere with the operation of the vehicle. The central and forward positions remain available for the driver and gunners. For cross-country movements, the driver should be where he can observe closely each obstacle that is in his path; hence, the logical place for him is in the bow. This position subjects the driver to severe jolts, because the pitch of the bow is greater than amidships; but he can brace himself against expected shocks far better than can a gunner who is intent upon handling his weapons. A gunner needs the steadiest gun platform that the machine affords; therefore, he should be amidships, where the jolts and vibrations are reduced to the minimum. The most desirable arrangement of the four main elements may be represented graphically as in Fig. 1.

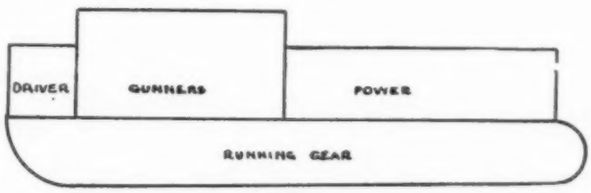


Fig. 1.

Accustomed as we are to the conventional arrangement of units in pleasure vehicles, this arrangement may look queer. However, pleasure and warfare differ; we are less concerned with the appearance of an armored car than with its efficiency as a fighting machine.

With these ideas on the arrangement of the main elements, we may proceed with other features of the design. Automotive engineers will have to produce the running gear and power plant; the using service must design the hull, with suitable facilities for the crew. Part of the problem is tactical and part is technical, but responsibility for results rests upon the using service. To secure results, the using service must state definitely what it wants.

VARIOUS forms of running gear have been tried. They include four wheels, six wheels, eight wheels, caterpillar tracks in rear and wheels in front, full caterpillar tracks, and a combination of wheels for the road with tracks for cross-country work. Driving power is usually applied to two, four, or six wheels; or to the caterpillar tracks through rear driving sprockets. The wheeled vehicles, when equipped with oversized balloon tires, have shown far better cross-country ability than the average commercial car, and their sustained speed on the road leaves nothing to be desired. However, even those with six-wheel drive bog down in soft ground, have insufficient traction for climbing steep slopes, and cannot surmount obstacles. Unless equipped with complicated dual controls for steering backwards or forwards, they require considerable room for turning. Caterpillar tracks in rear are better than wheels all around for cross-country travel, but not so good for speed on the road. The full caterpillar tracks give excellent service across country, and enable the

*Tank School, Fort George G. Meade, Md. Major, Cavalry, U. S. Army.

driver to turn his machine around in about half its own length; but the caterpillar machine cannot compete with wheeled vehicles on the roads. The combination of wheels for the road and full caterpillar tracks for rough going, is the most desirable that has as yet been produced. If the change from wheels to tracks, and reverse, can be made readily, this combination will meet all military needs.

For fast moving vehicles, springs and shock absorbers are essential. Even at slow speeds, vibrations and road shocks quickly wear out machinery that is rigidly supported by an unsprung frame, because every blow is transmitted directly to the working parts. In our rigidly constructed Mark VIII tank, vibration is so great that engine bolts must be tightened after each three hours of running time. Imagine what would happen if instead of six miles an hour this machine could attain sixty! A heavy armored car will encounter good roads, poor roads, and extremely rough going where there are no roads at all; and it must rely greatly upon speed to avoid destructive fire from the enemy's weapons. In a fast fighting machine, the stability of the gunner's firing platform is another important consideration which depends largely upon the elimination of vibration and jolts. Rigid construction entails inaccurate fire except at very low speeds; and even at a snail's pace, it is difficult for a gunner to keep his sights on the target. These considerations indicate the need for the best combination of springs and shock absorbers that can be devised.

Heavy armored cars must travel under their own power; they cannot be carried on trucks, as light tanks have been in the past. It will therefore be necessary to depart from the types of running gear that have been devised for tanks. The desired type should provide wheels for road travel, and full caterpillar tracks for cross country work. The tracks must be of high grade metal to combine light weight with strength and long life; and suitable devices must be provided for changing readily from wheels to tracks or reverse. The shape of the bearing surface of the track when adjusted for operation should approximate the arc of a great circle, as shown in Fig. 2, to enable the

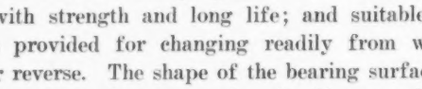


Fig. 2.

machine to surmount obstacles and to facilitate turning. Individually sprung wheels and double-action shock absorbers should suffice to eliminate most of the vibrations and jolts. These items cover the principal features of the running gear that is needed for a heavy armored car.

LACK of reserve power is a serious fault in any military vehicle. In commercial use, vehicles usually operate singly rather than in groups; each driver can take full advantage of conditions which favor his progress, and can avoid placing undue strain on his motor. In the military service, group operation and control is necessarily the rule. Even on good roads, drivers must often halt on steep grades and yet be prepared to maintain their proper places when the column moves on. While the column is moving, some machines will be going down hill while others are struggling up. Excessive extension of the unit or considerable reduction in speed will result, unless each machine has enough reserve power to meet unusual demands. In addition, military vehicles frequently have to operate on roads that commercial machines would avoid, and in areas where there are no roads whatever. In combat, an underpowered machine forces the driver to shift gears for minor obstacles, and thus increases greatly the time allowed for hostile gunners to register a destructive hit. The fighting machine must have plenty of reserve power to enable it to survive.

The maintenance and repair work on military vehicles must often be done in the open. Wind, sand, rain, mud, snow, sleet and cold impose far different conditions from those usually found in the steam-heated commercial garage. And when conditions are worst, tactical demands are often most pressing. The men available to do the necessary work will not be expert mechanics. There is, therefore, an especial need in the military service for an engine that is rugged in construction and extremely simple in design.

Invention and development are advancing so rapidly in the automotive industry that the sensation of today may be a back number tomorrow. Diesel engines, steam engines, and gasoline engines—some air-cooled and some water-cooled—present a bewildering array. Among the many excellent motors that our manufacturers produce, only those built for aircraft or for marine use have sufficient power to operate a heavy armored car. The aircraft motors will run efficiently whether top-side up or not, a very desirable feature, but none of them is designed to withstand the shocks of rough going across country. The marine motors are simpler and more rugged, but their water jackets require an unlimited supply of cool water to keep the engine at an efficient operating temperature. An armored car must carry its own water supply, and cargo space is extremely limited. An air-cooled motor of the type used in the Vickers medium tank (British) would afford distinct advantages, especially in freezing weather, but there are no high-powered American engines of this type except in airplanes. Obviously, the purpose for which a motor is intended governs its design. We are forced to the conclusion that the right motor for a heavy armored car has not yet been built.

Rather than wait until a proper motor is designed and put into production, we may proceed with an admittedly inferior substitute. Capable automotive engineers can produce the new engine long before the Army is ready to use it. Their problem is merely to add one more engine to the hundreds they have already designed; ours is to learn how to use this new weapon tactically, and how to defend ourselves against it. It is time for us to start on our share of the business with such means as are at hand. The Army has in storage some thousands of Liberty motors which can make shift to meet our needs temporarily. They have power (358 B.H.P. at 1400 r.p.m.), and are compact; at comparatively slight expense many of their original faults can be eliminated by rebuilding. Experiments with air-cooled Liberties, already started by the Air Corps, would provide designers with valuable data. The use of the Liberty motor, air-cooled or "as is," would involve excessive maintenance and repair work, but at least we would have something to use at once for tactical instruction.

For the benefit of those who are qualified to design an engine for use in our heavy armored cars, we may briefly summarize our needs as follows: simplicity, power (about 350 B.H.P. at 1500 r.p.m.), dependability, compactness, rugged construction, accessibility, and again simplicity.

HAVING thus disposed of the parts that will concern automotive engineers, we must now tackle our own share of the design. The first step will be to determine the shape and size of the hull. It must provide excellent observation;

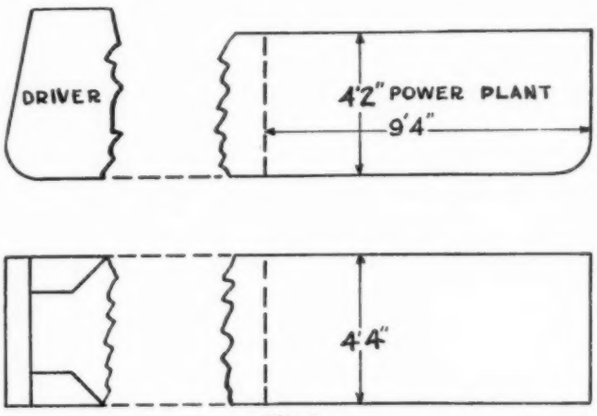


Fig. 3.

all-around fire; low superstructure and low center of gravity; balance; suitable clearance; and room for the power plant, equipment, and crew. These somewhat conflicting requirements will be troublesome, yet there are certain features which can be settled at once. The bottom of the hull will be flat, with bow and stern rounded to avoid scoop shovel action when pulling out of depressions; the driver will be in front, and the engine compartment in rear. Experience gained in the construction of tanks provides enough data for the design of these parts. Resort to the drawing board gives the following results for progress thus far. See Fig. 3. It is probable that with a power plant designed for use in a heavy armored car, the size of the engine compartment can be reduced, but for the present the requirements of the Liberty motor will govern. Experiments have shown that the space allowed above is sufficient. The space allowed for the driver is purposely made liberal to accommodate the facilities with which he must be provided. The main point to note is that the design provides the driver with excellent observation to the front and flanks.

The midsection of the hull must accommodate the remainder of the crew. As the driver will have his hands full, there must be at least one gunner to use the weapons. A third man in the crew, to handle signal communications, will double its efficiency; and a fourth would be desirable. If the size of the hull is to keep within reasonable limits, so that the machine will be readily maneuverable, it will be well to draw the line at four men.

To give this crew the maximum combat value, there must be communications equipment and weapons. Extensive experiments will be necessary to determine what should be included in the signal equipment. Radio telephone and telegraph, panels, semaphore flags, pigeons, heliograph, and pyrotechnics will all have to be tested for armored car use. The necessary space for the selected equipment must be provided, for signal equipment in an armored car is just as important as armament. As to weapons, there should be caliber .30 machine guns for use against personnel; a caliber .50 machine gun for antiaircraft fire; and a three pounder cannon to deal with hostile armored cars and tanks.

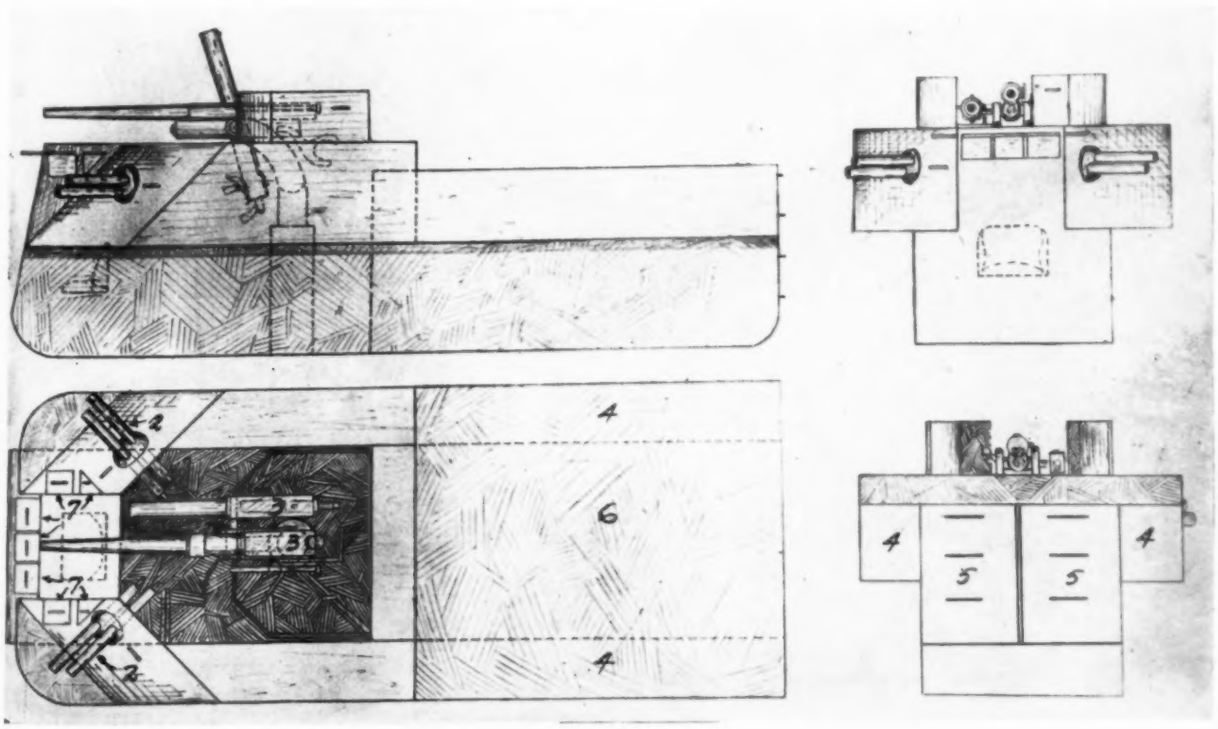


Fig. 4.

Much might be written about other items of equipment and detailed facilities that should be provided for the driver and for other members of the crew. Some of the items that need attention are:—Ammunition racks, an instrument board with luminous dials, compass, periscopes, gas masks, tools, spare parts, responsive controls, interior lights, head lights, tail light, flashlights, towing cables and brackets, individual lockers, fire extinguishers, fire-proof bulkhead for engine compartment, camouflage materials, splash guards, demolition equipment, photographic equipment, food and water containers. These and related matters are properly the subject for thorough investigations, which should be made with full sized wooden models before the first steel hull is built. Until these investigations have been made, we cannot draw up a complete design. It is possible, however, to prepare a lay-out that will accomodate at least the major items. Without more ado, we submit the following design (shown in Fig. 4) for the hull.

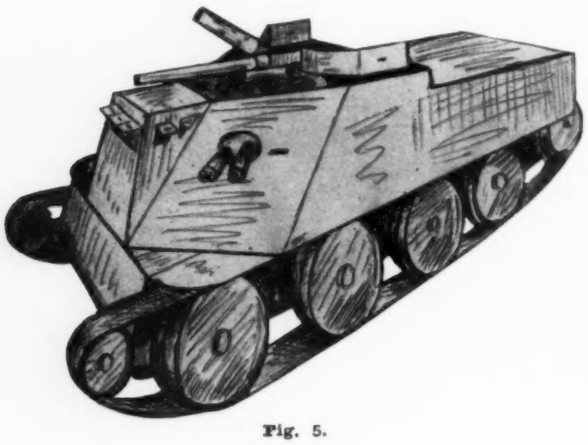


Fig. 5.

The following numbers refer to corresponding numbers on the sketches.

1. Fighting compartment (heavy line), extends out over running gear, normally open at the top, roof in suitable sections carried on top of engine compartment. Permanent roof over driver's seat. Front plates slope forward at an angle of 45°. Entrance and exit over the top.
2. Caliber .30 machine guns air-cooled, two in each mount. Horizontal traverse about 150°. Mounts placed to allow each gunner as much room as possible. Primarily for fire to the front and flanks against personnel; can also furnish some antiaircraft fire.
3. Three pounder cannon on pedestal mount, semiautomatic, high velocity, all around traverse. Small shield on gun to protect gunner from machine gun fire. Caliber .50 machine gun air-cooled, for antiaircraft fire, on same mount, to right or left of cannon.
4. Armored gasoline tanks, extend out over running gear, capacity 100 gallons each. Beneath the armor are inner tanks, selfsealing if punctured.
5. Water-tight hinged doors which give access to power plant. There are similar doors in the fireproof bulkhead which separates the fighting compartment from the engine room. Door handles serve also as steps of ladder to roof. Tool racks on inner surface of each door.
6. Flat roof of engine compartment provides a place for carrying caterpillar tracks when the machine is operating on wheels.
7. Observation ports, backed with thick shatter-proof glass, and protected outside by steel doors with suitable eye slits or holes for use when under fire.

THERE remains the important matter of fitting the running gear to this hull. As previously mentioned, the combination of wheels for the road with full caterpillar tracks for cross-country work, is most desirable for our purpose. Running gear of this type, invented by Mr. Walter Christie, is now undergoing tests on a new experimental machine. The performance of this gear to date has been fully satisfactory, but whether it will stand up under the full load of the completed machine, remains to be seen. The total weight of the machine, fully equipped and armored against caliber .30 bullets, will be about twelve tons. To travel at sixty miles an hour on the road and about thirty across country, this machine must have running gear of exceptional quality. The tracks particularly will have to be strong enough to withstand terrific strains, and yet light enough to permit easy removal and handling. The following sketch (Fig. 5) shows running gear of the Christie type combined with the hull described above. Note that the caterpillar tracks extend beyond the hull, so that neither bow nor stern can dig into an obstacle or steep bank.

In producing a new model automobile, manufacturers consult not only their designers but also the production, service, and sales departments. A similar system might well be applied to new fighting machines for the Army, but unfortunately we have no arm or service which combines these viewpoints under the control of one responsible head. Lacking such an agency, we must rely upon the coöperation of interested officers throughout the Army to point out mistakes and suggest improvements. Costly mistakes and needless delay will occur in building heavy armored cars unless we develop sound ideas on the fundamentals of design. In addition, there must be careful consideration of matters that affect production and service. The ultimate consumer—the using service—should get what it needs for tactical use in combat. If the using service neglects its share of the problem, it must be satisfied with what others produce.

Novel Design of British 6-Wheel Trucks

ACCORDING to *Motor Transport* (London), the new 6-wheel trucks furnished by the Karrier Company to the India Office for service with the army and civil authorities in India have a very interesting design. The principal points of the new vehicles are: (a) Eight forward speeds to allow high power for towing; (b) special tropical radiator (Clayton-Still); (c) improved accessibility; (d) long body space on chassis with driver alongside engine; (e) gas tank of non-ferrous material lead coated; (f) large single pneumatic tires instead of double tires on rear bogies; (g) elimination of overhang. Similar improvements have been made in the 6-wheel Guy chassis to meet the requirements for India and tropical colonial service.

Mobility of New 3-inch A. A. Guns

A 500-Mile March of the 62nd Coast Artillery

By John K. Christmas*

THE trend of modern military development is towards mechanization of all the functions of combat. The four main elements open to mechanization are: 1. Fire power; 2. Mobility; 3. Protection; and 4. Contributary and subordinate but complex functions, such as fire control.

An important element of any sizable armed force is a unit to protect the other arms against the attacks of hostile aircraft. Such a unit is an antiaircraft regiment. To be in keeping with the spirit of mechanization an antiaircraft regiment in a modern army must have, in some form, the four elements enumerated above. These take the following forms: the improved 3-inch antiaircraft trailer mount, M 1, with a high rate of fire is also very mobile while the difficult functions of fire control are performed by mechanical and electrical means. Regarding the third element, protection, it is neither necessary nor practicable to give mechanical protection (armor) to an antiaircraft battery; its protection lies in the fact that it is employed in the zone away from small arms fire, in concealment and in its own offensive power.

Fig. 1. New 3-Inch Antiaircraft Trailer Mount in Traveling Position.

In March, 1929, the War Department ordered the 62nd Coast Artillery (A. A.), permanently stationed at Fort Totten, N. Y., (near Brooklyn, N. Y.) to proceed to Fort Story, Va., (near Cape Henry, Va.) for its annual target practice and for some special firings against gliders in connection with the Air Corps from Langley Field, Va. The 62nd Coast Artillery (A. A.) is a mobile, or motorized, regiment and was ordered to proceed from Fort Totten to Fort Story *by marching*, this being at once a training in strategic mobility and a test of the new 3-inch antiaircraft mobile mount, M 1. Four of these guns were in the hands of the regiment, one being picked up at Aberdeen Proving Ground on the march south.

THE main items of equipment furnished this regiment by the Ordnance Department were: Eight 3-inch antiaircraft guns (4-M1, 4-M1918), antiaircraft machine guns, antiaircraft fire-control directors, fire-control instruments, sound locators, 5-ton tractors, trailers for the tractors, and artillery repair truck.

The 62nd Coast Artillery (A. A.) consisted of the following units:

Headquarters and band;
Headquarters battery;
Service battery.
1st Battalion:
  Headquarters detachment and combat train;
  Battery "A" (searchlights);
  Battery "B" (4 3-inch antiaircraft guns, on trailer mounts, M 1918);
  Battery "C" (4 3-inch antiaircraft guns on trailer mounts, M1) (new model);
2nd Battalion:
  Battery "E" (machine guns);
  Battery "F" (machine guns).

The march order issued by Col. H. C. Barnes, C. A. C., the regimental commander, directed that the march to Fort Story be conducted by battalion convoys. That is, the battalions marched as separate units under the battalion commanders. The writer, as an observer, accompanied the 1st battalion, commanded by Maj. L. B. Magruder, C. A. C.

The 1st battalion left Fort Totten, N. Y., at 5 A. M. March 18, 1929; the 2nd battalion left on March 19. The 1st battalion convoy consisted of the following vehicles:

4 guns, 3-inch antiaircraft trailer mount, M1 (new type);
4 guns, 3-inch antiaircraft trailer mount, M1918 (old type);
3 class B trucks;
9 searchlights on Cadillac trucks;
1 Chevrolet sedan;
4 rolling kitchens;
4 water trailers, 300 gal.;
4 trailers, 10-ton;
1 tank gasoline, 750 gal., F. W. D.;
1 Dodge light repair truck;
1 G. M. C. ambulance;
1 Artillery repair truck, F. W. D.;
5 White reconnaissance cars;
6 G. M. C. ¾-ton trucks;
2 5-ton artillery tractors, M1917;
34 trucks, F. W. D., 3-ton.
84 Total vehicles.

The personnel of the 1st battalion consisted of 11 officers and about 275 enlisted men. A medical officer and an ambulance were attached.

*Assistant Chief, Automotive Section, Artillery Division, Office of the Chief of Ordnance, Washington, D. C. Captain, Ordnance Department, U. S. Army.

The itinerary of the march is given in the table below.

The 3-ton F. W. D. trucks used as prime movers for the guns and other trailed loads were of the type procured for the Army in the World War. Briefly, this is a 3-ton truck, four wheel drive, solid-tired and powered with a 4 cylinder 36 H. P. engine; it is equipped with a cargo body and canvas top, (See Figure 3). This truck, while it did excellent work in service during the late war, is now over ten years old in design. Added to this, the majority of the trucks in the 62nd Coast Artillery were *old in point of mileage*, and a good number practically worn out. The condition thus existed of having a new and highly efficient antiaircraft trailer mount drawn by an obsolete and in many cases worn-out prime mover.

Fig. 2. 3-Inch Antiaircraft Mount in Firing Position.
Change from traveling to firing position requires 15 minutes.

ITINERARY OF 500-MILE MARCH, 62nd COAST ARTILLERY (A. A.)

Place	Date of Departure	Mileage	Total time on the road	Rate: Miles per hour, including all halts
Fort Totten, N. Y.	March 18	59.7	12 hrs. 15 min	4.9
Raritan Arsenal, N. J.	March 19	59.9	13 hrs. 08 min	4.6
Frankford Arsenal (Philadelphia, Pa.)	March 20	41.9	8 hrs. 50 min	4.8
Wilmington, Del. (Armory)	March 21	46.9	8 hrs. 10 min	5.7
Aberdeen Proving Ground, Md.	March 22	58.2	11 hrs. 25 min	5.1
Fort George G. Meade, Md.	March 23	52.2	16 hrs. 40 min	3.1
Sunday, rest and overhaul	March 24	(at Ft. Humphreys, Va.)		
Fort Humphreys, Va.	March 25	41.3	7 hrs. 55 min	5.2
Fredericksburg, Va. (Armory)	March 26	51.8	10 hrs. 0 min	5.2
Richmond, Va. (Armory)	March 27	66.3	9 hrs. 50 min	6.7
Fort Eustis, Va.	March 28	42.0	10 hrs. 0 min	4.2
Fort Story, Va. (arrived)	March 28			
Total		520.2		
Averages: (Per day, Sunday excluded)		52.0	10 hrs. 50 min	4.8

Average of total of daily halts: 4 hours, 15 minutes (approx.); this gives a *mean running rate of* 7.9 *miles per hour*, a good figure for the trucks used.

Leaving Fort Meade a second class road was encountered which delayed the convoy considerably although the principal delay was caused by the inability of the trucks to pull the guns up the short steep grades on this road. Over this road it took the convoy five hours to march eleven miles.

THE 3-inch antiaircraft trailer mount, M1, was initiated by the Ordnance Department in 1926 and the first pilot mount tested at Aberdeen Proving Ground in October, 1927. This gun has now been adopted as standard equipment. This weapon consists of the latest type of 3-inch antiaircraft gun mounted on the new improved four-wheel trailer mount, equipped with 40-inch by 9-inch balloon tires inflated to 55 pounds per square inch. The firing platform and the necessary long outriggers to give the mount stability in its firing position have been ingeniously designed so that the whole carriage is a compact vehicle weighing about 8 tons, with a 66-inch wheel tread and a 160-inch wheel base. The overall dimensions of this weapon in traveling position are: length—25 feet; width—77 inches; height—108 inches. The center of gravity is only 44 inches above the ground giving the carriage excellent stability on its wheels. The gun is 50 calibers in length and is equipped with a removable liner; the muzzle velocity is 2600 f. s., giving a vertical range of about 10,000 yards and a horizontal range of about 15,000 yards. The maximum rate of fire is about 25 shots per minute. Figure 1 shows this remarkable mount as it was convoyed on the road by the 62nd Coast Artillery, and Figure 2 shows the mount in firing position. To go from the road or traveling position to the firing position *requires only fifteen minutes.*

Fig. 3. Section of Convoy, 62nd Coast Artillery.
The new antiaircraft gun and the old F. W. D. truck.

The march of 520

miles from Fort Totten, New York, to Fort Story, Virginia, showed that this carriage rides literally "like a touring car," which is of great importance in prolonging the life of the gun and in protecting its delicate mechanisms. Although the speeds ordinarily used in the convoy were from 10 to 15 miles per hour, due to the limitations of the F. W. D. trucks used, the speed at times went up to about 20 miles per hour coming down hill. At no time was there any objectionable sway or vibration of the trailer mount. The special mechanical four-wheel brakes provided were so effective that they held not only the gun carriage but, coming down hill, also the heavy towing truck which, in many cases, had very poor brakes. The brakeman rides in a seat on the left rear of the carriage and operates the brake with a hand lever. The march has demonstrated that the trailer mount, both as concerns the equipment and the personnel, can be taken safely on long campaign or strategic marches at speeds up to 25 miles an hour, such as could be maintained with modern vehicles (trucks). The tests made in the Mechanized Force at Fort George G. Meade, Maryland, in the summer of 1928, with modern high speed prime movers have demonstrated conclusively that this carriage may be towed safely over good roads at speeds up to 40 miles an hour. The mobility of this carriage is, therefore, all and more than is necessary, and is only contingent on supplying the necessary modern truck to furnish the motive power.

Fig. 4. 5-Ton Tractor on Trailer—For Tactical Mobility of Guns.

The normal *strategic moves* (moves approaching the battle) of antiaircraft units will be made over hard or improved roads allowing the use of wheeled prime movers or trucks. After the antiaircraft unit arrives in the theatre of operations near its intended firing position, it can be moved *tactically* (in the combat zone) by its truck where practicable. Where access to the intended position is impracticable with a truck or wheeled prime mover, the trailer mount is detached from the truck and is pulled into its final position across country by a small track-laying (5-ton or equal) tractor. One such tractor is carried in each battery particularly for that purpose and to pull out wheeled vehicles that are mired. The 62nd Coast Artillery is provided with the 5-ton tractor, M1917, on a standard trailer for use in such *tactical* movements, as shown in Figure 4; these tractors are now being replaced by two new Caterpillar "20" tractors.

THE march of the 62nd Coast Artillery was of 520 miles, which is a very long strategic move even for a motorized regiment to make under its own power. It is believed that in most cases in time of war such long moves would be made partly by boat or rail. The time consumed in making this march is not exceptionally good, but it is about what can be expected with the obsolete and partly worn-out truck equipment with which this regiment was provided. The performance is nearly the same as that obtained in convoys of the Experimental Mechanized Force at Fort George G. Meade, in the summer of 1928, when it is considered that in the E. M. F. loads as heavy as the 3-inch antiaircraft trailer mount, M 1, were ordinarily towed either by a Class "B" (Liberty 5-ton) truck or by some modern heavy commercial truck. It is my opinion that a certain appreciable part of the difficulties encountered with the motor equipment on this convoy, and in other Army convoys as well, must be laid to the type of enlisted personnel furnished. The increasing complexity and quantity of technical equipment provided the various combat units of the Army today demand a more intelligent and a better-trained type of enlisted man than is now being obtained generally with the existing pay ratings, to which must be added the difficulties of training personnel due to large turn-overs of enlisted men.

As a corollary to the excellent mobility of the new 3-inch antiaircraft trailer mount, as well as to its superior efficiency as a firing weapon against celestial targets, it may be of interest to discuss the possibility of using this carriage for terrestrial fire, i.e., against ground targets. While this weapon was not primarily designed for terrestrial fire, its excellent mobility, its high rate of fire, and its very complete and reliable fire-control system make it an excellent weapon for many forms of terrestrial fire. This form of carriage (pedestal mount) is not now considered, due to its weight and the length of time required to go into position, the most desirable for light field artillery, but we all know that in time of war the capable type of leader will make use of any means at hand to accomplish his objective. With the terrestrial fire capabilities of the 3-inch antiaircraft trailer mount there would arise in combat many occasions where a commander could and would make use of this weapon for terrestrial fire. Some such occasions may enumerated:

1. Where our planes control the air the antiaircraft battery could be used to augment the barrage in an attack.
2. In a defensive battle, due particularly to the excellent fire control of this weapon, it could be used very effectively against fast-moving attacking tanks.
3. The antiaircraft artillery being already in position somewhat behind the light artillery, the former could be used in emergency to cover the withdrawal of the forward elements of a retreating army.
4. As the Coast Artillery also plans, this gun man be used against fast-moving unprotected naval targets, such as destroyers and mine-layers.

ANOTHER aspect of the excellent mobility of the new 3-inch antiaircraft trailer mount lies in its greater value as a coast defense weapon against air attacks. The

fixed antiaircraft battery can with advantage be emplaced in positions of importance near large cities, important harbors, industrial plants or arsenals, many of which are almost sure to be objectives of enemy air attack in time of war. However, even in these objectives there would be a large element of uncertainty as to which of the objectives the enemy would select for his attack. Also, in a country as large as ours the warfare would be very unlikely to extend all over the country; it would be more likely to be localized in a certain section such as New England, Southern California, or Florida. It is manifestly very expensive, and in time of peace almost impossible, to provide adequate fixed antiaircraft defense for *all* important cities, industrial plants and government activities. With the highly mobile 3-inch antiaircraft gun, this is not necessary for as the war develops and localizes itself in certain sections, the antiaircraft defense of that section may be quickly augmented by drawing in from all over the country the necessary, and perhaps all, available *mobile* antiaircraft units. This has the advantage of concentrating our total antiaircraft effort at the point where it is most needed, while at the same time lessening the financial burden of antiaircraft defense in time of peace.

Further, if the war be of any considerable duration the objective is likely to shift in which case the antiaircraft defense may be shifted to the new zone of combat with very little difficulty.

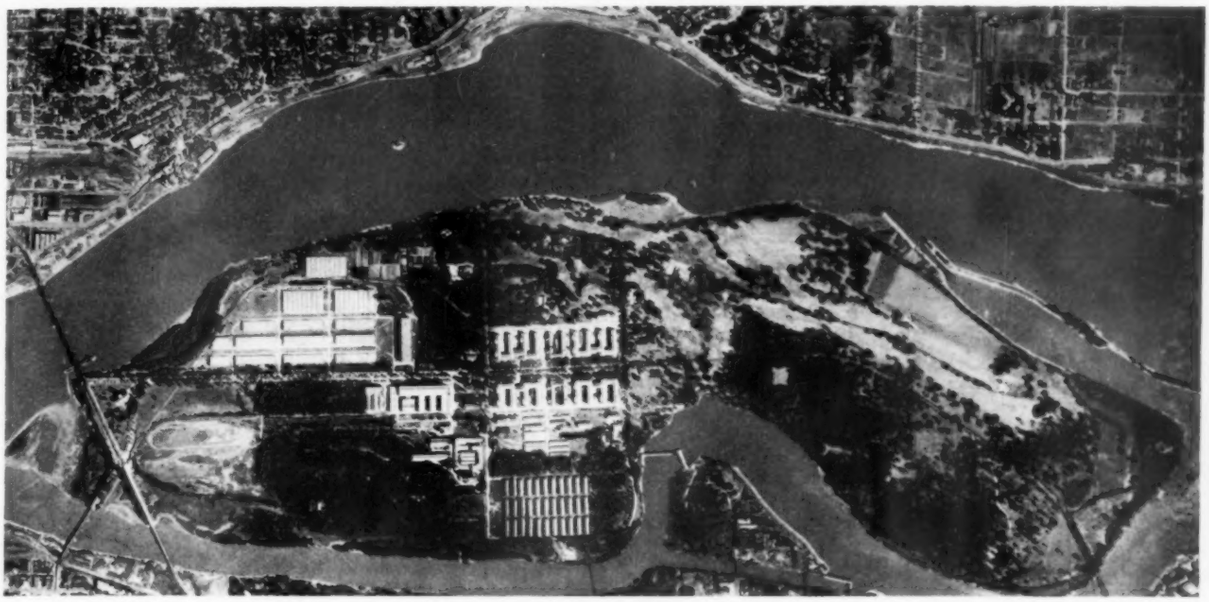
It might not be out of place here to state that this new gun, with its newly developed nearly automatic fire control has roughly a *five times greater efficiency* in hitting airplanes than the weapons used during the World War, as well as a much greater mobility; but we must also bear in mind that the effectiveness of an antiaircraft gun lies not only in its actual hits on attacking airplanes, but in its potential hitting power and in its moral effect on the enemy by its mere presence and fire. While recognizing the latter factors as being very large, it is, of course, impossible to measure this phase of an antiaircraft gun's value as it depends somewhat on the skill and daring of the enemy aviator. However, it may certainly be considered that the effectiveness of an antiaircraft gun, in keeping away enemy planes by its threat, or potential power, is at least as great at its power to keep away enemy planes by actually bringing them down. The so-called moral effect of an antiaircraft gun may be likened to a man swinging a saber: he need not strike his opponent, in most cases, in order to keep him away.

ANOTHER important element of any weapon, particularly in the United States, is the degree of training required of its personnel. The 3-inch antiaircraft gun and its accompanying fire-control mechanism have been so built that automatic mechanical devices perform the functions of much highly trained personnel and do those functions better. Such personnel we would not have available in any quantity on the outbreak of a war and takes many months to train. This takes care of that element of this weapon which has to do with its fire power. As regards its mobility, that is only dependent on providing ordinary truck transportation, and no other country has a larger or better reserve of trained automobile drivers and mechanics. That this is so was well demonstrated on the convoy described herein, as this regiment contained a large proportion of recruits, in spite of which with obsolete motor equipment this regiment made a march of over 500 miles with no serious accidents, adhered to its previously laid down schedule and maintained in running order a great deal of poor motor equipment. As an index to the condition of the trucks in this regiment it may be stated that on one day of this march ten of the F. W. D. trucks were towed into camp at the end of the day. Again, on the last day of the march, so many vehicles were out of order that in one case an F. W. D. truck was pulling a rolling kitchen, a 3-inch antiaircraft gun and a disabled F. W. D. truck. A number of F. W. D. trucks were left behind at Raritan Arsenal at the end of the first day's march, overhauled F. W. D. trucks being borrowed from that arsenal to replace them.

In taking note of the time lost on this march, due to halts, it should be noted that after the third day, a "maintenance section" was organized and orders issued that when a vehicle became disabled it was to drop out of the convoy to be picked up by the maintenance section running at the tail of the convoy. The maintenance section then either repaired the vehicle, if this could be done in a reasonable time, or took it in tow into camp. In this way the main body of the convoy was enabled to proceed on scheduled time with a ten minute halt every hour. Before instituting this method of procedure it had been the practice to stop the whole convoy whenever a truck fell out, thereby losing considerable time. Another cause of considerable delay was the necessary time to halt for lunch, this time being from 1½ to 2½ hours. In time of emergency this time could be considerably reduced or eliminated by having cold lunches issued to the men in the morning before starting.

The daily march averaged 52.0 miles, which, considering the prime movers provided for these heavy loads (8 tons), is very good; *it is over twice the daily march that could be expected from a horse-drawn light artillery unit* over the distance this regiment marched. On some days the march could have been made considerably longer had it not been necessary to halt at military reservations or armories, where arrangements for camps had been made beforehand. Somewhat better time could have been made, it is believed, with Class "B" trucks as prime movers for the guns; this estimate is based on the performance of the 1st battalion of the 6th Field Artillery in the Experimental Mechanized Force in the summer of 1928, when daily marches of seventy to eighty miles were made on several occasions. What the daily march could be with modern truck equipment is, of course, only an estimate, but it is believed that 150 miles a day would be not at all unreasonable. In closing, a word must be said for the zeal and ability of the officers and men of this regiment in making this long march under the considerable handicaps due to malfunctioning and inadequacy of the motor equipment. No serious accidents occurred either to the personnel or property, and this although many of the men were recruits and all of them were tired from long hours on the road, to which were added additional hours spent in making and breaking camp.

It is believed that the American Army has a mobile 3-inch antiaircraft gun equal, if not superior, to that of any other nation, in its accuracy, fire power, dependability and mobility, with the increasing mechanization of armies the latter quality is of prime importance.



Airplane View of Rock Island Arsenal.

Maintaining Our Munitions Reserves

Methods Used at Rock Island Depot to Preserve Ordnance Stores

By D. M. King*

THE Rock Island Ordnance General Supply Depot, which was established in March, 1918, took over the duties formerly belonging to two departments of the manufacturing arsenal, the property section and the storehouse. At that time, the depot was removed from the control of the arsenal commander and placed directly under the Supply Division in Washington. After the World War, the organization was again changed so that the arsenal commander is now the accountable officer for the property and, of course, exercises direct control over the depot.

The duties of the depot consist of the issue, receipt, storage and maintenance of a great many different kinds of ordnance and ordnance stores.

Most of the shipments from Rock Island Ordnance Depot consist of tractor and artillery parts, but smaller quantities of articles belonging to almost all of the other groups of property are included. There is no artillery ammunition on hand and the shipments of small arms ammunition are small, but, even so, 6,800,000 pounds, valued at $2,500,000.00 were shipped out during 1928.

The average time which elapses between the date of receipt of order and date of shipment is two weeks. In many cases, considerable delay is caused by incorrectly prepared requisitions which must be completely rewritten before the shipping ticket can be made out. Considerable time is frequently spent in selecting and packing orders, which include a great many different kinds of things which have to be carefully packed to avoid breakage, and also to take advantage of the lowest freight classification. In addition to all this, small shipments are frequently held up for combination into carload shipments. Considerable use is made of pasteboard cartons, but, with this exception, stores are shipped in boxes and crates made from old lumber. This adds somewhat to the cost of labor and transportation, but obviates any cost for lumber.

During 1928, 5,985 sales were made having a value of $48,209.81. Generally these are shipped within 24 hours after receipt of order, and practically all of them within 48 hours.

A traffic section, similar to that found in many of the larger commercial plants, performs valuable work for the depot and, indeed, for the whole arsenal. Immediately after the close of the war, the depot management realized that large savings were available to the Government through the more businesslike handling of traffic. Two men, with considerable railroad experience, were brought in and put to work. In the beginning, difficulties were encountered due to the fact that definite land-grant deductions could not be obtained and that rates applicable to ordnance stores had not been established. Although the land-grant situation is still rather involved, we have recorded, for ready reference, the best routings and rates to our most usual shipping points; and, through the coöperation of the proper officials in Washington, have succeeded in establishing a great many special rates on ordnance stores. In addition to this, we have succeeded in having the arsenal placed within the express delivery zone, and in having special trap car service so that the amount of trucking between the arsenal and the City of Rock Island has been greatly reduced and efficient handling expedited.

*Commanding Officer, Rock Island Arsenal, Rock Island, Illinois. Colonel, Ordnance Department, U. S. Army.

Artillery Vehicle Storehouses at Rock Island Arsenal.

AT THE time of its organization, the activities of the depot were confined, for the most part, to one building with material stored in parts of five other buildings. Between 1917 and 1920, more than 66 additional buildings were constructed. Some of these have since been torn down, but those now used by the depot include: a thoroughly modern six-story concrete warehouse, 140 by 540 ft.; 30 hollow tile and concrete buildings, 50 by 200 ft., intended for nitrate storage, but used, in addition, for magazines and general storage; and 15 other buildings used principally for the storage of artillery matériel. In addition there are 12 small tile and concrete magazines; a magazine; two large storehouses and "The Arsenal Building," begun in 1865, the first ordnance building on the island.

To move supplies in and out of these buildings and, of course, the shop buildings as well, there are on the island more than 15 miles of railroad track, a considerable portion of which has to be kept in usable condition.

Rock Island was designated as a reserve depot and construction of the large number of buildings, already mentioned, was started; but, when the war ended and the shipment of stores to Rock Island got well under way, the rate of arrival was beyond any possible rate of assimilation in the way of permanent storage. At one time, there were about 300 carloads of material piled in the open, besides about half that amount simply thrown on the ground. Some of the stores were badly packed and considerably damaged in shipment; these needed to be repaired, others needed overhaul due to extended use and improper cleaning, and still others needed to be disassembled to permit of an economical use of storage space. Much thought was given to the preparation of the various classes of matériel for permanent storage before the necessary shop and depot work could be started.

Method of Storing Field Gun Recuperators.

THE rifles, automatic rifles, and machine guns were all disassembled, cleaned, repaired, reassembled, greased, and packed away in boxes. The optical instruments were disassembled, cleaned, reassembled, and packed away in heated storage. The 75-mm. guns and carriages were disassembled for cleaning and for storage. The guns were piled in such a way that they can be cleaned and greased without being removed from the piles; the shields were stacked separately, the wheels were piled by themselves, and the trail assemblies arranged in such a way as to use the minimum amount of space. The recoil mechanisms were completely disassembled, rebuilt, and prepared for service. Special racks, constructed for the purpose, support these mechanisms in such a way that a single one can be removed without disturbing the others, and so that all can have the reserve oil replaced and the position of the packings changed without removing the recoil mechanism from the racks. The disassembly of the other artillery was not carried so far, nor were the recoil mechanisms so carefully overhauled. The howitzers and most of the guns were piled in the same way, but the wheels and shields were not removed from the carriages. Some of the recoil mechanisms were filled with hydrolene and some were slushed with grease. To keep informed as to the condition of this matériel, yearly percentage inspections were prescribed. As a result of these inspections, many changes in methods of storage have been found necessary.

With respect to the rifles and machine guns, it has been found that barrels which are rusted and pitted cannot be sufficiently well cleaned, by any mechanical means so far employed, to keep new rust from forming. Experiments are now being conducted in the use of acid for the removal of rust and, in cases where the storage is expected to continue for a long time, barrels which are noticeably pitted or rusted are being rejected. Much of the grease used for rust prevention has been found to increase noticeably in its acid content, leading to the conclusion that, in time, this grease actually will attack the metal.

In the storage of optical instruments, the attempt to hold them at a constant temperature has not been successful in preventing the condensation of moisture on the opti-

Method of Storing Artillery.

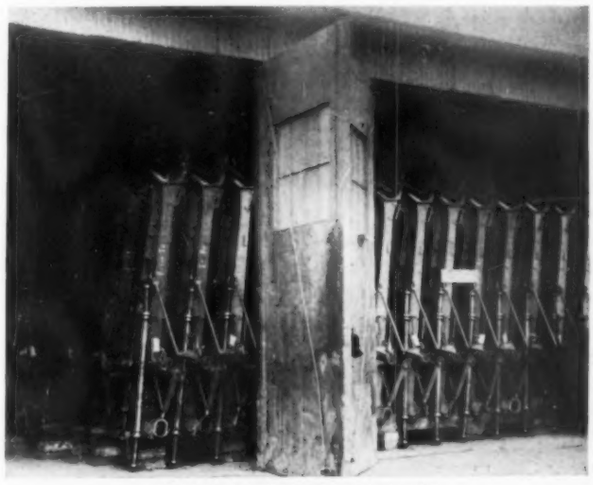
cal elements. Although methods of sealing these instruments have been greatly improved so that there is good reason to believe that those overhauled now will remain serviceable for much longer than those overhauled immediately after the war, we try to limit the overhaul to instruments which we expect to issue within the next year or two.

The long continued storage of wooden wheels has proved to be very unsatisfactory. So much shrinkage occurs that it is necessary to reset the tires and, in many cases, when this is done the resulting wheel is too small to meet the specifications.

The trail assemblies for the 75-mm. carriages were at first stored with the axles assembled. It was found that water accumulated inside the axle housings, causing the axles to rust and freeze in place. All axles have now been removed and stored separately. The recoil mechanisms for the French 75's are in much better condition than those for any other matériel. This seems to be due to the fact that the work of rebuilding was very carefully done, and further to the fact that recoil oil and nitrogen are good rust preventatives. There has been some rusting, presumed to be due to improperly dried nitrogen, and other rusting where the packing has been allowed to remain in one position for several years. When the position of the packing is changed several times a year, this latter rusting is avoided. There are some unexplained cases in which the acid content of the recoil oil has increased greatly in the course of several years. This is looked upon as a condition which may be expected to cause rust. On account of the high cost of rebuilding these recoil mechanisms, the unserviceable ones returned from the field during the past two years have been disassembled and slushed with a rust preventative.

THE carriages for the 155-mm. howitzers, with the exception of the recoil mechanisms, are stored assembled. While there has been some rusting of trails and other parts, this has not been such as to affect the serviceability of the carriages. The condition of the recoil mechanism is unsatisfactory. Those which were stored, filled with hydrolene, were rusted quite badly. A good deal of the hydrolene leaked out and that which remained did not prove to be a rust preventative. Many of those which were slushed with grease also rusted quite badly. In some cases, the coating of grease slipped off and, in other cases, there was rusting under the grease. In both instances it is probable that the surfaces were improperly cleaned. In those mechanisms where the packings were left in place the rusting at the packing seats was much worse than elsewhere. As these conditions were discovered, corrective methods were adopted, but many of these proved to be inadequate. Gasoline and finally cleaners' naphtha were substituted for kerosene as a cleaning liquid, men handling surfaces already cleaned for greasing being required to wear gloves, and rust was removed with emery cloth and wire brushes used with increasingly great thoroughness; still the rusting continued. It was finally acknowledged that most of these mechanisms could not be reassembled for service without lapping the walls of the cylinder so as to remove the pitting. There seems to be very good reason for believing that new rust will form wherever any old rust remains, and that this old rust cannot be completely removed by any ordinary mechanical means short of machining off the metal to the depth of the pits. As no method of grinding these long small bore cylinders has been developed, it is necessary to lap away this metal. This is a very expensive process and there is no assurance that the formation of rust in new places can be prevented. These conditions have made it necessary for the depot to develop some comparatively inexpensive method for the complete removal of rust.

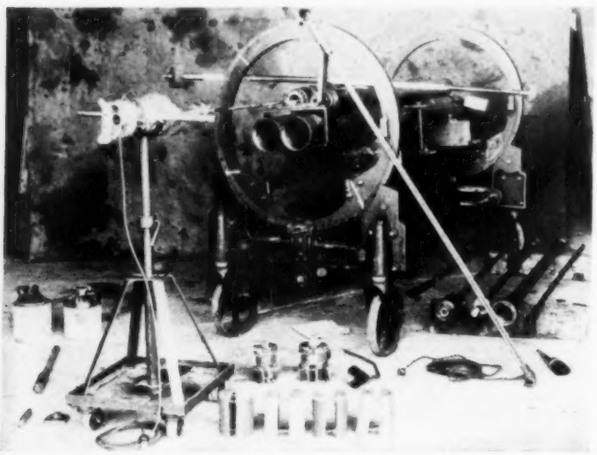
The method developed at another depot consists of the use of a specially constructed wire brush driven at high speed by an air motor. This seems rapid and effective for slight pitting, but becomes slow and expensive when



Method of Storing Gun Trails.

the pitting is very deep. This method has been used at Rock Island Arsenal only in an experimental comparison of different methods of cleaning.

AFTER laboratory experiments extending over a period of more than a year, the Rock Island Ordnance Depot finally decided to use chemicals for removing the rust. At the same time, the laboratory conducted other experiments



Apparatus for Cleaning and Slushing Recoil Mechanisms at Rock Island Arsenal.

for the purpose of improving the quality of the rust preventatives available. Due to close coöperation between the arsenal and several manufacturers and to a change in the specifications, permitting the acceptance of a higher melting point grease, rust preventatives of much better promise have been secured. In addition to this, a special shop method has been developed for smearing on an even and closely adhering coat of this improved rust preventative. To obtain accelerated rusting tests, special "humidity cabinets" have been fitted up for use in testing the new methods of cleaning the surfaces and of applying the rust preventatives and in an endeavor to build up a weathering test which will be independent of the season of the year. The outdoor weathering test, in the present specifications, will permit the acceptance of a grease tested in winter when the same grease tested in summer would fail. The cabinets are kept at a temperature of 100°F and a humidity of, as nearly as possible, 100 per cent. One cabinet is supplemented by a violet ray machine which is intended to imitate the effects of sunlight. The tests conducted with these instruments are very interesting, but have not advanced far enough to justify the writing of new specifications.

To return to the acid cleaning of recuperators, the method developed in the depot consists of the use of a 10 per cent solution of sulphuric acid to which has been added a proprietary inhibitor to reduce the action of the acid on the clean metal. This acid solution is drained off, the residue neutralized with a caustic solution followed by a hot water wash, after which the surface is dried with alcohol. The result is a clean surface for the application of the rust preventative. This method has now been in use for more than a year with uniformly good results. The efficiency of inhibitors in pickling solutions is not generally recognized. In an experiment recently performed at the arsenal laboratory, a test plate was immersed in a pickling solution composed of 10 per cent sulphuric acid with 10 per cent of a proprietary inhibitor added. The highly polished steel test plate was left in the solution for a period of 12 hours. At the end of that time, there was no visible formation of hydrogen bubbles and the high polish of the plate remained unchanged. During this same time quite a heavy coating of rust was removed from another part of the plate. In cleaning recoil mechanisms the surface is scrubbed with a wire brush to accelerate the action of the acid.

Some of the 155-mm. howitzers are deeply pitted in the powder chamber and some in the bore. These are now being cleaned by a method somewhat similar to that used for the recoil mechanisms except that, as it is not convenient to scrub the surface during the treatment, the acid is left in for a longer time and a larger percentage of the inhibitor is used.

Although the subject of rust prevention is a large one and the work done here covers only a small part of it, we believe that a solution to our immediate problem has been obtained.

Rock Island Arsenal is unusually fortunate in the matter of civilian personnel. The same high type of permanent employee is found in the depot as in the manufacturing section of the arsenal. In the depot total of about 100 are found more than 50 men who have been at the arsenal for over ten years. For honest and faithful performance of duty and constant effort for the improvement of methods, it is felt that the depot organization is one of which we can feel justly proud.

Gliders Used as Antiaircraft Targets

USING small motorless airplanes as targets for their antiaircraft firings the 61st and 62nd regiments of antiaircraft artillery are conducting their annual target practice at Fort Story, on Cape Henry, Virginia. Both 3-inch antiaircraft guns and machine guns as well as searchlights are being used during these firings. The movement of the 62nd Coast Artillery to Fort Story from its regular station at Fort Totten, N. Y., is described elsewhere in this issue. The 61st Coast Artillery is stationed regularly at Fort Monroe, Virginia.

During these firings the regiments are given the first opportunity that any antiaircraft artillery has had to fire at "glider" targets—small motorless airplanes which are carried aloft by and launched from regular airplanes and which have special controls that can be set so as to permit the gliders to reproduce the movements of an airplane as they glide to earth. The targets are launched at altitudes of from 8,000 to 10,000 feet. Ordinarily, when set for steady flight, they will descend in circles of varying diameter, their actual course being dependent upon the wind. High speed boats are provided for recovering the gliders after they fall into the water. The employment of glider targets in this country is based on the excellent results in Germany in the use of gliders.

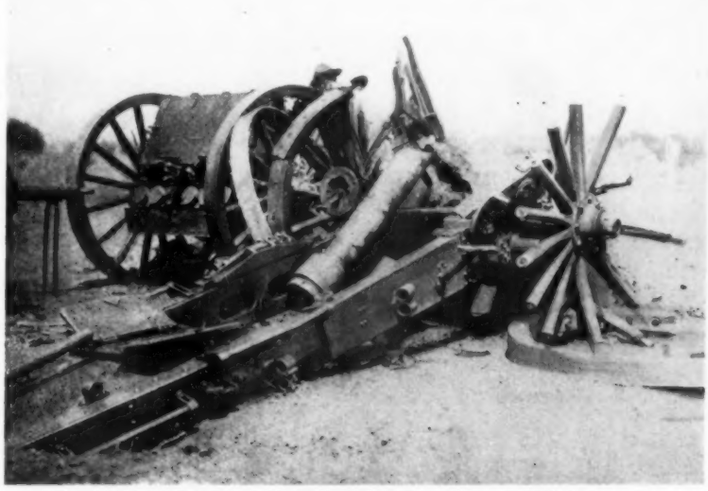
During these firings joint training with the Air Corps will be carried out. Part of the two regiments will be sent to Langley Field, Va., where they, in coöperation with the Air Corps, will engage in the defense of an airdrome. The enemy forces are represented by certain units of the Air Corps based in the nearby vicinity.

Corps Area Ordnance Activities

The Responsibilities of Supply, Inspection and Maintenance

By C. T. Harris, Jr.*

THE United States Army is composed of the Regular Army, the National Guard and the Organized Reserves. The continental United States is divided geographically into nine corps areas, beginning with the First Corps Area, New England, and ending with the Ninth Corps Area, the states on the Pacific Coast. In each of these corps areas there is either a full Regular Army division and two National Guard divisions or else a nucleus of a Regular Army division together with two National Guard divisions. Normally in each corps area, there are, in addition, three reserve divisions (inactive). Each corps area is placed under the command of a corps area commander, who is charged with the command of the Regular Army units and the supervision of the inspection, supply, training and development of the National Guard and Organized Reserves. Each corps area commander is provided with a suitable staff, one of the members of which is the corps area ordnance officer. As such staff officer of the commanding general, the corps area ordnance officer concerns himself with all ordnance activities within the corps area.



What May Happen if Ordnance Inspection and Maintenance are not Well Performed.

THE corps area ordnance officer, as an operating agent of the corps area commander and in accordance with approved policies, supervises all ordnance functions of supply, alteration, inspection and maintenance of ordnance matériel under the jurisdiction of the corps area commander. In the matter of supply, the ordnance officer is authorized to order issued from arsenals and depots designated by the Chief of Ordnance to any station within the corps area, such quantities of ordnance matériel as are available and as are authorized by existing orders for the proper supply of troops. The corps area ordnance officer is charged with the inspection and maintenance of all the ordnance matériel in the possession of the Regular Army (except the stations exempted from the control of the corps area commander, at which an officer of the Ordnance Department is detailed as ordnance officer), the National Guard and the R. O. T. C. In addition, inspection of ordnance matériel at exempted stations may be made by corps area ordnance officers acting as special representatives of the Chief of Ordnance, when specifically authorized and directed to do so. In carrying on the work of inspection, maintenance and alteration, armament and ammunition foremen, resident armament and traveling armament machinists and ordnance enlisted men are provided.

Unserviceable, surplus and obsolete ordnance matériel is disposed of by the corps area ordnance officer in accordance with instructions received from the Chief of Ordnance. The corps area ordnance officer is also authorized to function as an inspector in condemning and disposing of worn out ordnance matériel. He is the technical advisor to the corps area commander on matters pertaining to ordnance, and, as such, is required to give full attention to the functioning of ordnance matériel in the hands of troops. He must report to the Chief of Ordnance, through military channels, any matter of technical importance which he may observe. He conducts correspondence courses for Organized Reserve officers, is charged with the training and assignment of Ordnance Reserve officers of the territorial assignment group and maintains records pertaining to these reserve activities. He maintains the office of record in all matters pertaining to armament, the supply of ordnance in the hands of troops and available for issue in emergency, and to the ordnance personnel under the jurisdiction of the corps area commander. He assists in the preparation of war plans insofar as they pertain to the supply and maintenance of ordnance matériel.

IN performing the duties outlined above, the corps area ordnance officer is assigned certain technical and administrative assistants. His office is organized usually into four general sections, as follows: administration section, charged with the general administration of the office, its personnel and all civil functions relating thereto; supply section, charged with the functions of supply; armament section, charged with the inspection, alteration and maintenance of armament and all technical matters connected therewith; training section, charged with training activities pertaining to the ordnance personnel of the Regular Army, the ordnance personnel of the National Guard and the ordnance personnel of the Organized Reserves. The functions

*Corps Area Ordnance Officer, Second Corps Area, Governor's Island, N. Y. Major, Ordnance Department, U. S. Army.

and duties of these sections will be described in some detail hereinafter.

The corps area ordnance officer is charged with the general supervision of the whole office and with the coördination of the several sections and their respective functions. To assist him, two ordnance officers are usually assigned to duty in the corps area ordnance office.

Administration Section: The administration section is charged with all matters pertaining to mail and record, distribution of correspondence, civilian personnel, estimates, expenditures and accounting of funds, messenger service and office facilities. The administration section functions under the chief clerk, usually a Civil Service employee who has a thorough knowledge of Civil Service regulations and finance and accounting methods. Records pertaining to civilian personnel, such as time-keeping, appointments, separations, retirements, injuries, disabilities, etc., are maintained in the administration section. The estimates for funds to be submitted each year to the Chief of Ordnance are here prepared from data furnished from the other sections of the office. The financial records, obligations and expenditures, as well as records of purchase, are kept in this section. Vouchers covering civilian pay-rolls, per diem and traveling expenses of civil service employees, officers' mileage and traveling expenses, financial reports, cost records and analyses of expenditures are prepared in the administration section. The smooth working of the office depends largely on the efficiency with which the administration section functions.

Equipment for Repairing Ordnance in the Field.

Supply Section: All requisitions for ordnance matériel are handled in the supply section. The requisitions, upon receipt, are checked as to nomenclature, allowances, availability of funds for transportation, and, in the case of the National Guard, the Reserve Officers' Training Corps, Organized Reserves and Citizens' Military Training Camps, as to the availability of funds for transportation and packing charges and for reimbursement of funds for matériel where the items requested are not items of free issue. Each requisition, when checked as to form, authority for issue and availability of funds, is approved and forwarded to a depot for issue with authority to expend funds for transportation and other purposes when required. The post or organization submitting the requisition is then advised of the action taken.

The supply section passes on all reports of survey covering ordnance matériel which has been damaged or destroyed or become unserviceable. The supply section also reviews inventory and inspection reports covering ordnance matériel which has become worn out through fair wear and tear or has become obsolete. Instructions as to the disposition of ordnance matériel covered in the above categories are issued by this section. The accountability for office property and special inspection tools is carried in the supply section. Statistical records covering issues of ordnance matériel to Regular Army, National Guard, Organized Reserves, Reserve Officers' Training Corps, schools and colleges and other authorized agencies are compiled and submitted periodically to the Chief of Ordnance.

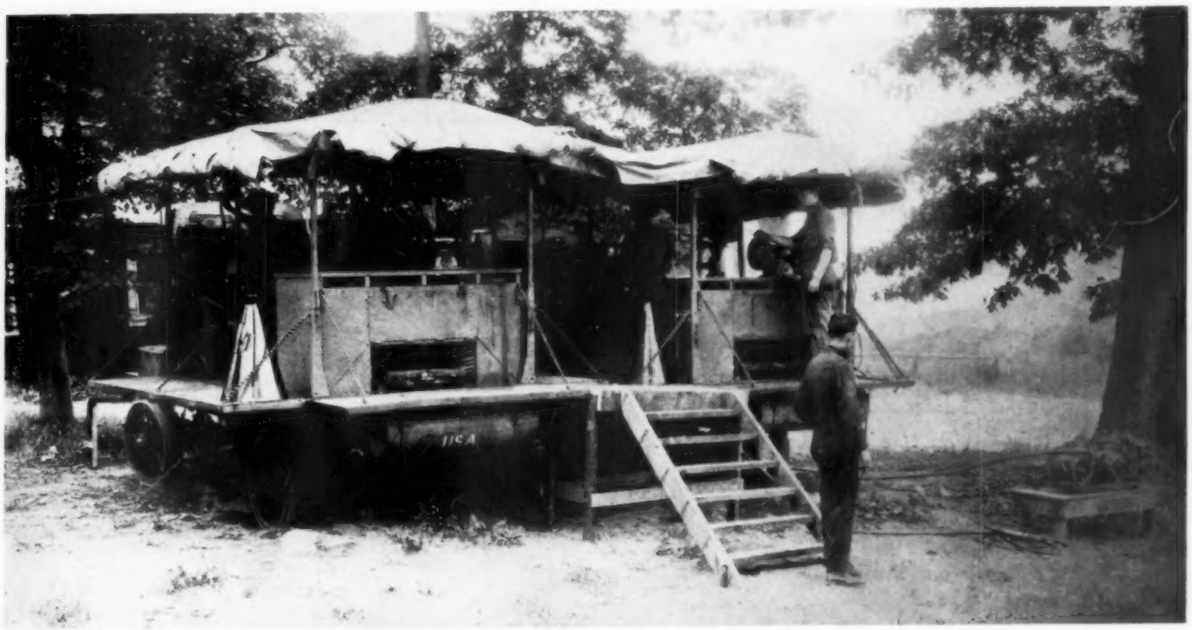
A record by serial numbers of automatic rifles, rifles, pistols, revolvers and shot guns in the hands of the Regular Army, National Guard, Organized Reserves and other authorized agencies, is kept and in the case of theft of such arms, a report of these serial numbers is made to the Police Departments and others interested. Tables of organization and equipment charts are maintained in the supply section. The supply section also handles correspondence and issues instructions concerning issues of obsolete ordnance matériel and captured trophies to patriotic societies, American Legion Posts and other organizations to which such issues are authorized by law.

Armament Section: The armament section, headed by one of the commissioned assistants to the corps area ordnance officer, handles all matters pertaining to inspection, maintenance and alteration of ordnance matériel under the

jurisdiction of the corps area commander. This section maintains matériel history records of all ordnance together with the files of ordnance drawings. It issues and distributes work orders covering alteration, maintenance and repair work. The records of all inspections, together with records of corrective action required thereby, are filed in the armament section. The armament section directs and supervises the work of the ordnance field agencies, keeps track of progress made and prepares periodic progress reports for the information of the corps area ordnance officer and the Chief of Ordnance. The work of the armament section will be discussed more in detail later.

The ordnance maintenance company is equipped with trucks containing light machine tools, benches and hand tools, a small forge equipment and facilities for welding. Supplies of spare parts are also carried so that the company is well prepared to do emergency work in the field.

At each of the Regular Army posts in the corps area, an ordnance sergeant and usually one or more ordnance noncommissioned officers and privates are stationed to assist the post ordnance officer (usually detailed from the line), in his duties of maintenance and supply pertaining to that post. In addition to this ordnance military personnel, civilian mechanics are provided. A resident machinist is



Maintenance Shop Trucks Set Up for Operation.

Training Section: The training section, under the direction of one of the commissioned assistants to the corps area ordnance officer, is charged with all the training activities of the Ordnance Office with reference to the ordnance personnel in the Regular Army, the National Guard and the Organized Reserves. This section conducts correspondence courses, conducts examinations for promotions of Reserve Officers, and supervises the summer training of Ordnance Reserve Officers. Training programs are prepared which, when approved, form the basis of training. Intimate contact with Reserve Officers and National Guard Officers is maintained, and, in the winter season, interesting lectures covering appropriate military subjects, are arranged to which all Reserve Officers are invited. This section works in close harmony with the Ordnance Procurement Districts in adjacent cities and through coöperation endeavors to secure maximum training efficiency.

WHERE a Regular Army Division exists in the corps area, an ordnance light maintenance company is assigned to that division. The maintenance company is commanded by an ordnance officer and consists of ordnance personnel. This company normally performs the maintenance work pertaining to the ordnance matériel of the division, except where the repair work is of such an extended character as to require the use of arsenal facilities.

usually on duty in each of the harbor defenses for the purpose of maintaining the artillery and other ordnance matériel in serviceable condition. These resident machinists are men of extensive experience with armament and they become very skilful in diagnosing troubles and in correcting them. An armament and an ammunition foreman are available in each corps area. The armament foreman, under the direction of the corps area ordnance officer, supervises the work of the resident, armament and travelling machinists on all ordnance matériel except ammunition. The ammunition foreman supervises the work similarly on ammunition and ammunition components throughout the corps area. In addition, the ammunition foreman performs the duty of safety inspector pertaining to the storage of ammunition at posts, camps and stations. Both of these foremen assist the ordnance officer in the annual inspection of ordnance matériel. Due to the many small arms in the hands of the Regular Army, National Guard, etc. and the many stations in which small arms are located, the services of a civilian small-arms inspector are required for the entire year. In these inspections, each small arm is examined visually and tested with various gages. Unserviceable arms are directed to be turned in to arsenals for repair, and minor repairs are made locally at the time of inspection. The serviceability and efficiency of small arms have been increased very materially due to the annual

inspection of these weapons. Traveling armament machinists are used as trouble shooters and sent to places needed, particularly to the training camps in summer.

ALL ordnance matériel within the corps area is required by regulations to be inspected annually by the organization of the corps area ordnance officer. As a result of these inspections, repairs and corrective measures are prescribed to eradicate difficulties and malfunctioning and to repair damages and breakages to ordnance matériel. This inspection and resultant corrective activities constitute one of the most important responsibilities of the corps area ordnance officer and is one to which he should give a large part of his personal attention. The efficiency of the ordnance matériel in time of stress may depend on the efficiency of these inspections. Inspection reports are prepared on prescribed blank forms covering the functioning of each element of ordnance. Prescribed tests are made and as a result of these tests and visual examinations, the serviceability of the ordnance matériel is determined. Inspection reports are made a part of the permanent record of the corps area ordnance office. At the time the inspection reports are prepared, a list of deficiencies and a list of corrective measures necessary are prepared and furnished to the organization commander concerned and to the ordnance field agency charged with performing the repairs prescribed. Reports are required to be rendered when the repairs and maintenance work have been completed. These reports are filed with the inspection report itself, which closes that inspection cycle for the year.

Ammunition is inspected in somewhat the same manner, special attention being given to conditions of safety in storage. Corrective measures are prescribed as before and the inspection reports are made of permanent record.

Malfunctioning of ordnance matériel at all times is reported to the corps area ordnance officer and he takes necessary measures to correct the defects, using traveling machinists as well as the armament and ammunition foreman and his office assistants to take care of each situation as it arises.

As previously stated, the small arms in the corps area are inspected annually by a civilian small arms inspector who has been especially trained in this work. The inspection records and corrective measures necessary are recorded and carried out in the manner prescribed above. The scope of this inspection work may be visualized when it is realized that there are in the Second Corps Area, for example, 124 different localities in which there are organizations having rifles, machine guns, or automatic rifles and in this number, New York City is counted as only one place, although the time of the inspector for some two months is required in New York City alone. There are 39 different localities in which artillery matériel is located and to which the inspector has to go. In addition to the annual inspection and maintenance activities resulting therefrom, much maintenance work is done in the summer camps.

AN important responsibility of the ordnance organization in the corps area is that of supply. The desire of the Ordnance Department is to give efficient service to the line of the Army and unless efficient service is given in supply, the Army very properly feels resentful. Requisitions are prepared by local ordnance officers and submitted to the corps area ordnance officer who arranges to have the required matériel supplied. The supply organization is particularly active in the spring getting ready for the summer training activities of the Regular Army, the National Guard, the C. M. T. C., the R. O. T. C., and the Organized Reserves. The supply section carefully analyzes the needs as to spare parts, ammunition and other ordnance stores and sees to it that at each camp and at each station where summer camps are held, adequate supplies are available at the opening of the camp.

The field training of all the elements in the Army takes place during the summer season; therefore, this becomes a very busy season for the ordnance organization in the corps area. The coast artillery units in the corps area are trained at a suitable coast artillery post. The infantry units of the Regular Army usually train near their home stations and as a part of this training include the annual small arms target practice. The infantry units of the National Guard often train at a state camp operated by the states; for example, in New York the infantry units of the National Guard train at Peekskill, and in New Jersey the infantry units train at Sea Girt. These camps are maintained and operated by the respective states. The ordnance maintenance at infantry camps is not particularly difficult since spare parts for small arms are available and small arms do not require the careful attention required by field and heavy artillery. The field artillery units in both the National Guard and Regular Army train at appropriate points in the corps area; this training includes target practice. In the Second Corps Area the mobile artillery training of the National Guard and Regular Army is carried on at Pine Camp, N. Y. and Fort Ontario, N. Y. The 155-mm. guns are fired over Lake Erie from Fort Ontario. Pine Camp is the most important artillery training center. The reservation is the property of the United States and is sufficiently large to allow field maneuvers and firing of all of the mobile artillery except the 155-mm. guns. The National Guard of the State of New York maintains permanently at Pine Camp an operating organization.

ONE of the interesting and important activities in the corps area just now is the renovation of seacoast ammunition. Much of this ammunition was loaded under conditions not conducive to accurate work and a number of shell are being unloaded and reassembled. New fuzes are being installed in much of this ammunition. The shell are loaded at the coast defenses by an ordnance detachment furnished for this purpose. This detachment goes from post to post. The filler used is explosive D and is loaded into the shell under pressure, a drop hammer being used. This work will continue to engage the attention of the corps area ordnance organization for several months. There are miscellaneous activities connected with ordnance in the corps area that come up from time to time, such as proof firing, relocation of batteries, etc. War planning is an activity which requires thoughtful attention.

The corps area ordnance officer, as stated previously, is a staff officer of the corps area commander and as such feels a keen interest and responsibility in everything pertaining to ordnance within the corps area. Under the existing organization, the means are available to a corps area ordnance officer to carry out his duties. The Chief of Ordnance and his office always have supported to the highest degree the field agencies of the Ordnance Department.

Civilian Personnel in the World War

The Record of the Twelfth Civil Service District

By Charles L. Snyder*

THE declaration of war by Congress on April 6, 1917, brought tremendous responsibilities upon the Civil Service Commission as well as upon the War and Navy Departments. It became the immediate duty of the Commission, not only at Washington but in the remotest portions of the country, to supply promptly the rapidly increasing civilian personnel to carry on the functions of the Government. The story of how this was done in the Twelfth Civil Service District, 3000 miles from the National Capital, is the subject of this article.

In 1918 the Twelfth District comprised the six states of the far Southwest from Colorado to California, the district office being located at San Francisco which was also the headquarters of the Ninth Corps Area of the Army and of the Twelfth Naval District which included the Mare Island Navy Yard, the largest on the Pacific Coast.

On April 1, 1917, the personnel of the district office comprised the district secretary and six employees, which was sufficient to handle the current business of the district in time of peace. As the war progressed, this force was rapidly increased by employees detailed chiefly from the War and Navy Departments, until on September 1, 1917, it comprised 23 employees, or an increase of nearly 250 per cent in 5 months. Within the next 4 months the force was raised to 28, the maximum number employed.

Immediately following the declaration of war the district secretary personally called at the principal offices of the War Department in San Francisco, and stated that he believed it would be the policy of the President and of the Civil Service Commission to fill all vacancies in civilian positions as promptly as possiple by competitive examinations rather than to exempt from examination any large groups of employees in the Government service. In this connection he urged the closest possible coöperation in the effort to accomplish this result.

In the furtherance of the plan promptly to supply eligibles locally, the district secretary was authorized by the Civil Service Commission as early as April 14th to undertake the local rating of certain examination papers, and within a few weeks was rating nearly all of the papers required to fill clerical, typist, and stenographic positions. Previously all work of this kind had been done in the central office of the Commission at Washington. The Commission also, acting under an executive order, authorized the use of certain eligible registers of state and municipal civil service commissions, and thus augmented the number of eligibles immediately available

THE earliest and most extensive requisitions from both the War and Navy Departments were for male clerks qualified to use the typewriter, and for a limited number of male stenographers. In the absence of sufficient qualified eligibles for stenographer and typist positions, many of these vacancies were filled from the general clerical or first grade register by certifying the names of those who claimed experience in typing, but had not passed the typing tests. Later, when it became more difficult to secure male eligibles because of the number of men drafted into the military service, the departments were persuaded to use female eligibles of which the supply was ample at all times. At a later date, upon the rec-

The Civil Service Organized for War

TO the average mind, war means soldiers and sailors, guns and battleships, powder and provisions. To those who know it means these and more. Nowadays it means that the whole economic structure of the belligerent country must be organized on a war basis. The military establishments must have the backing of an enlarged and efficient civil service, and even private industry must submit to a measure of governmental control in the interest of the great end in view.

It is probable that few persons realize that during America's participation in the World War the civil service of the United States, at the height of its expansion, numbered one for every two men who were sent overseas to do the actual fighting. Nearly a million men and women were employed in the executive civil service of the United States to help keep the machinery of war in motion. In the nineteen months in which the United States was active in the War, the United States Civil Service Commission gave examinations under the civil service law to slightly less than a million persons. It supplied to the service about 400,000 new civilian recruits whose qualifications had been tested through competitive examinations.

These civilian employees, appointed from the Civil Service Commission's registers of eligibles, represented practically every kind and class of occupation, from ordinary unskilled labor, through mechanical and clerical workers of all kinds, to the highest grades of technical, professional, and scientific positions.

The following article in which Mr. Charles L. Snyder, Secretary of the Twelfth United States Civil Service District, describes the methods employed by his office in recruiting civilian workers for the military establishments, is a cross-section, so to speak, of the vast machinery set up by the Civil Service Commission to recruit the host of new civilian employees needed to stand behind the men behind the guns.

GEORGE R. WALES,
Member, U. S. Civil Service Commission.

*Secretary, Twelfth United States Civil Service District, San Francisco, Calif.

ommendation of the district secretary, examinations were held successfully to obtain men with Army or other similar valuable clerical experience. Upon similar recommendation material modifications were also made in the examination standards for certain positions, which served to increase materially the number of eligibles available for local appointment.

In addition to the work performed directly in the interest of the War Department, the resources of the district office were heavily taxed to supply the needs of the Navy Yard at Mare Island, which required approximately 7000 to 9000 employees during the active period of the war, and as high as 11,000 following its close. To facilitate this work a branch office of the Labor Board was established in San Francisco in August 1918, and functioned directly under the supervision of the district secretary. Through the efforts of this office the securing of many additional employees was rendered practicable. This agency was continued for approximately a year following the close of the war, and during that time furnished several thousand eligibles for appointment.

I HAVE read with great interest Mr. Snyder's article upon the operation of the Twelfth Civil Service District in 1917-1918. *It is a convincing record of the operation of the district. The mobilization plans of the San Francisco Ordnance District have from the first provided for the procurement of all civilian personnel through the agency of the local Civil Service. To facilitate such employment in the early days of an emergency, this district expects to work in closest cooperation with the Civil Service and have in the civilian personnel section of this office a representative of the Civil Service, or at least a personnel man who is thoroughly familiar with its procedure and who will act as a personnel liaison with the office of the Twelfth District. I am confident that an entirely satisfactory civilian personnel can be obtained through the agency of the Civil Service and that we shall be able to enjoy at all times its many advantages, among which I consider the freedom from the inevitable personal and political pressure concerning appointments made to Government positions in an emergency.*

BRUCE CORNWALL,
Chief, San Francisco Ordnance District.

From the beginning of the war until its close, local examinations were held so frequently and rated with such promptness that practically no temporary appointments in clerical or other similar positions in the War and Navy Departments were approved for San Francisco or vicinity, and very few such appointments were made elsewhere in the district in positions for which the papers were rated in the district office. At no time in the previous history of that office was the number of temporary appointments at San Francisco and vicinity so small in proportion to the number employed, as during this period.

IN view of the historical nature of this paper it is believed to be desirable to use quotations from the original records, as far as practicable, to tell the story. This is made comparatively easy by reason of the fact that beginning in April 1917 the Commission required weekly and other extensive reports from the district secretary, concerning local conditions in the district.

The following quotations from these reports will give a graphic picture of the practice of the Twelfth District Office during this momentous period, and will serve to describe quite definitely the efforts made by the district secretary to carry out the civil service procedure at that time. The reports written during the first few months of the war at the time when the official machinery was being organized for carrying on the work in this district, are believed to be of the greatest value as showing the rapid adjustment to war conditions, and will, therefore, be quoted more fully than reports of the activities carried on later.

Owing to the distance of the Twelfth District Office from Washington, the district secretary found it necessary to proceed in many cases without definite or detailed instructions from the central office of the Commission. In practically every instance, however, where initiative steps were taken by him to expedite the furnishing of eligibles to the great military departments, his action was fully approved by the Commission.

The story will now be told chiefly in quotations from official letters and reports from the district secretary to the Civil Service Commission at Washington. On April 11, 1917, the following letter was written to the Civil Service Commission:

"Referring to certification of eligibles at San Francisco to vacancies in the offices of the War Department of this city, I beg leave to state that I have considered the need of these offices as paramount to those of the departments not concerned in military preparations, and have certified eligibles from the stenographer and typist registers to War Department offices regardless of the fact that other departments have made prior requisitions. I presume that such action at this time is fully warranted by the military conditions and that I may continue to regard requisitions of military departments as having the right of way in case of any shortage of eligibles. * * * Subject to your approval, I expect to certify eligibles on clerical registers with claims of experience in stenography and typewriting or in typewriting, to meet the needs of the service in the absence of eligibles on the regular stenographic and typewriting lists.

"From conference with War Department officials it seems probable that there will be enormous demands for men qualified as clerk-typewriters, and the only hope for meeting the requisitions for this class of help lies in certifying eligibles on other registers who claim experience of the kinds indicated. While certifications from claims of experience are not warranted by the Civil Service rules or the Commission's regulations, I assume that I am justified in the present emergency in using the widest discretion in endeavoring to fill vacancies with the least possible delay."

On the same date another letter written to the Commission contained the following:

"Yesterday was a very busy day in this office in connection with appointments to clerical positions in the War Department offices of this city, and certifications were made to about fifty vacancies. * * * I personally con-

ferred with the Department Quartermaster and his chief clerk and with the chief clerk of the Army headquarters, with respect to their prospective needs for clerical help. Both of these offices state that the work has only commenced and in their judgment very large numbers of civilian employees for classified duty will be required by them. There is a very great demand for male typewriters or for clerks who can use the typewriter machine, and unless some extraordinary measures can be invoked to hold examinations for such positions without delay, and to rate the papers with the utmost dispatch, there will be a flood of temporary appointments in the absence of eligibles. What I fear is that the moment the gates are open to the filling of these positions outside of the eligible register, the offices will be flooded with importunities for appointment for political and personal reasons, and the spoils system will obtain a foothold in the department, from which it will be hard to dislodge it. * * * I cannot express too strongly how important I feel the necessity for rating papers for these examinations immediately upon their receipt by you. This is a time when delays are dangerous not only to the military service, but to the perpetuation of the merit system for civilian positions. I flatter myself that I have laid the foundation for a splendid spirit of coöperation between my office and the War Department offices as well as the Navy Department, but unless I can provide eligibles all of my fair promises come to naught."

A telegram sent to the Civil Service Commission on April 13th, was as follows:

"Cannot promptly supply sufficient male clerk-typewriters war offices here. Recommend authorization immediate appointments available applicants pending satisfactory evidence training and experience and passing simple copying test on typewriter non-competitive to be rated without delay. Eligibles to be regarded regular appointees during war emergency but not for transfer without further examination. Only alternative temporary appointments outside of register. Likely to be abused as spoils."

On the following day, April 14th, a telegram was received in reply, as follows:

"Authorized immediate appointments typewriters as you recommend in telegram. Letter follows."

A LETTER of April 16th included the following statement:

"The Army activities of the entire Pacific Coast are being directed from the headquarters in this city which is the center of all the Army work west of the Rocky Mountains. The officers concerned are being called upon to enlarge their personnel very rapidly and are facing serious difficulties in the effort to obtain men who can quickly learn their new duties. I have personally conferred with the principal officers concerned and am keeping in close touch with the chief clerk of each office in order to assist him in the difficult tasks he has to accomplish at this time. * * * The War Department offices are finding from time to time men with clerical experience who are able to use the typewriter and who are of unusual value to these offices. I feel they should be permitted to employ these men as they find them, without delay and upon a very simple test of fitness in addition to the evidence of experience in army work. * * * I believe that I can continue to secure the cordial coöperation of the War Department offices here in making appointments through Civil Service examinations, if I can promptly supply persons of the required qualifications or can aid the Department in verifying the claims of qualifications of candidates for immediate employment."

The following was written on April 23rd:

"I have gone ahead in the plan to provide eligibles for clerk-typewriter positions for the War Department offices as rapidly as possible. The burden of rating the papers here is going to be a very heavy one and it may be that I will have to send a number of these papers to you for prompt handling. If I do I cannot too strongly urge the necessity of immediate action if we are to hold the Civil Service Department together here in handling the war emergency. * * * Acting upon the large discretion which the Commission has given me, I have already taken considerable liberty with the certification rules in endeavoring to provide the War Department offices with this urgently needed help without delay."

On April 14, 1917, the Civil Service Commission authorized the district secretary to hold a limited form of typewriter examination, and to rate locally the papers with a view to providing eligibles without delay.

On April 23rd the district secretary with reference to this matter wrote as follows:

"I have taken immediate steps to prepare a circular of information to nominating officers, embodying the plan proposed. It will be noted that I contemplate holding examinations every week and will endeavor to have the papers rated with the least possible delay."

On April 28th the following was stated in a letter to the Commission:

"Referring to the urgent need for additional clerks in the War Department offices in San Francisco, my attention has been called to several cases where men who have had excellent experience in Army clerical work, such, for instance, as that of a quartermaster sergeant or of an army field clerk, are desired for immediate appointment in these offices. It has seemed to me that these cases might constitute proper cases to be passed upon by the Commission, with a view to giving regular appointment by exception from the Civil Service rules, or upon appropriate noncompetitive examination. Where such cases have come to my attention, I have authorized the appointing officers to make immediate appointments and to present the facts for the further consideration of the Commission through this office."

Referring to the plan for holding local examinations and rating the papers in the district office, a letter of April 30th contained the following:

"The first examination under this plan will be held tomorrow. * * * I will endeavor to mark the emergency examination on the plain copy test and application without delay, and will create the supplementary register approved by the Commission."

THE following report was made to the Commission on May 22nd:

"I am pleased to say that at the present time there is no serious or embarrassing shortage of eligibles for clerical positions in offices of either the War or Navy Departments. A large number of vacancies have been filled with

great promptness by the use of the first grade eligible register, selection being made upon the basis of typewriting experience claimed and as a result of supplemental typewriter registers prepared from examinations held every Tuesday in this office. The chief clerks of two of the most important Army offices in this city have expressed great satisfaction with the promptness with which vacancies have been filled and with the qualifications of the eligibles secured. Within the first thirty days following the declaration of war, more than 500 eligibles were certified by the district office, chiefly to positions in San Francisco and vicinity and largely to the War and Navy Department offices. As a result of the prompt action taken by me, no temporary appointments have been authorized except in cases of the utmost urgency and in positions for which no available eligibles could possibly be provided. I also made special efforts in advance of the Commission's instructions to have the war emergency appointments treated as probational, and in this manner sought to overcome the difficulty and embarrassment attendant upon mere temporary appointments. A very large degree of coöperation was sought and secured from the local offices in this respect. At the present time only positions clearly of a temporary nature and for brief intervals of time, are regarded as temporary. * * *

"I have given the military departments the right of way in certification of clerks, typewriters, and stenographers, and have required the non-military offices to defer their requests as much as possible or to use temporary appointees pending certification. I have also taken steps to urge upon all offices the advisability of appointing women wherever practicable instead of men, to clerical and stenographic positions."

A letter of May 31st contained the following:

"It has been the practice to rate immediately the male applicants examined on Tuesdays, and to certify the appointees within 24 hours to places of actual employment. As a result of the practice agreed to by the War Department, the appointees are assigned to duty, usually within 24 to 48 hours after the time of examination."

On June 6th a report contained the following paragraph:

"Since April 6th, 315 certificates for appointment have been issued by this office, a large share of which has been to the local military offices."

In a letter dated June 14th it was stated that:

"In the military offices in San Francisco all demands of War Department offices for clerk-typewriters have been fully met. * * * I have also succeeded in filling all existing vacancies in the offices at the Mare Island Navy Yard."

A report made on July 12th was as follows:

"The number of temporary appointments, both in Los Angeles and in San Francisco, has been reduced materially during the past week by a large number of appointments of both clerks and packers in the Depot Quartermaster's offices. The only temporary appointments now pending are in positions where Army clerical experience is required, or where male stenographers and typewriters have been requested at $1,000 or $1,200 per annum. I hope to be able to fill any vacancies at $1.200 within a few days. * * * If the appointing officers are willing to fill all the existing vacancies from the female stenographer and typewriter register, there will be no temporary appointments when this action is taken. I regard the temporary appointment situation as very satisfactory in the military offices."

A paragraph in a letter written September 5th reads as follows:

"The local rating of examination papers is progressing very satisfactorily and continues to be of very great value in supplying promptly the urgent needs of all branches of the service. I am gratified to say that I believe that at no time in the history of this district has it been possible to meet so promptly the needs of the various departments for all classes of appointees as at the present time. This condition has been brought about very largely by the local machinery which the war emergency has called into existence in this office."

A REPORT submitted on December 31, 1917, contained the following:

"Since the first of April, 1917, a period of nine months, 7,000 applications have been filed. During the same period 1,600 certificates have been issued to appointing officers, exclusive of appointments in post offices and other branches where formal certificates are not required. This number is fully four times as great as the number of such certificates issued during the corresponding period of last year. * * *

"The year which ends with the quarter has been the most momentous and important in the history of this district. * * * It is believed, however, that the unusual conditions which so rapidly developed after the declaration of war, have been met in a satisfactory manner and that the business of the district office has been carried on in such a way as to reflect credit upon the Commission."

In a letter written April 9, 1918, approximately a year after the declaration of war, the following statement appears:

"The number of eligibles appears to be sufficient for the filling of general clerical and stenographic positions, and for sub-clerical positions where the rates of pay are sufficient to induce eligibles to accept appointment. * * *

"In submitting this report which is the first weekly report in the second year of the war, I may briefly state that during the past year nearly 12,000 applications have been handled by this office for local appointments in the district, and more than 2,100 certificates have been issued to appointing officers. * * * The volume of business handled has been about four times the normal volume of the preceding year."

On November 9, 1918, two days before the signing of the Armistice, a report submitted contained the following statement:

"During the past week the business of certification and appointment has continued in about the same volume as heretofore, and the number of vacancies filled has been comparatively large. The receipt of applications, however, has fallen off very materially and the interest of the general public in the examinations has seemed to diminish greatly. This condition is probably due to the prevalence of the influenza epidemic, and also to the belief that the great war is nearly at an end and that the needs of the Government may be modified by this fact."

Semiautomatic Rifle Competition

Ordnance Department Invites Inventors to Submit Weapons for Competitive Tests

THE War Department is interested in securing a satisfactory developed semiautomatic shoulder rifle. The general requirements of such an arm are as follows:

The rifle must be of a self-loading type, adapted to function with cartridge of caliber .276 to be furnished by the Ordnance Department. The cartridge will be of approximately the following characteristics: bullet, gliding metal jacket, weight 125 grains; cartridge case, rimless type; powder charge sufficient to impart a muzzle velocity of 2700 f. s. to the bullet heretofore described; for the working powder pressures, the limit will be approximately 48000 pounds per square inch. The rifle must be simple and rugged in construction and easy of manufacture. It should require but little more attention than the regular service rifle when placed in the hands of the average soldier.

It is planned that competitive tests of arms of this character will be held about July 1, 1929, at the Aberdeen Proving Ground, Md. The War Department may receive and subject to preliminary examination and test such rifles as inventors may care to submit prior to competitive trials. Persons having semiautomatic rifles which they desire to submit for competitive test should address the application for such test to the Chief of Ordnance, United States Army, Washington, D. C.

FOR the guidance of inventors in perfecting a design of this type the following information regarding characteristics has been furnished:

The following features are considered necessary. *a*. The rifle must be simple, strong and compact. Weights should be well balanced and so placed that the essential strength is given to components requiring it. Ease of manufacture should be a guiding factor in preparing a design.

b. The mechanism must be well protected from the entrance of sand, rain, or dirt and should not be liable to derangements due to accidents, long wear and tear, exposure to dampness, sand, etc.

c. Components of the mechanism should be the fewest possible, consistent with ease of manufacture and proper functioning of the weapon. Parts requiring constant cleaning or which may require replacement should be designed with a view to ease of dismounting by the use of not more than one small tool, preferably the service cartridge.

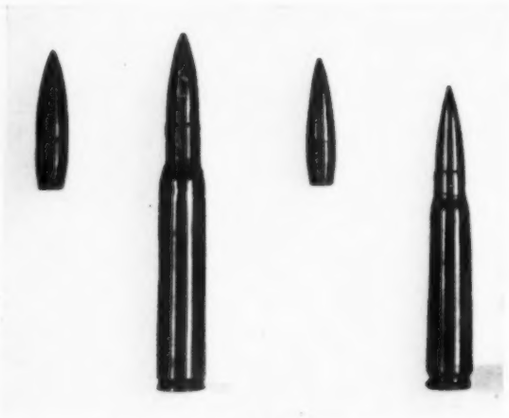
d. The rifle must be so designed that the magazine may be fed from clips or chargers. The magazine may be detachable, but this is not considered desirable. The capacity of the magazine should not be less than five rounds, preferably ten, but not to exceed ten rounds.

e. The breech mechanism must be so designed as to pre-

Two Semiautomatic Rifles to be Entered by the Ordnance Department in Competitive Tests and the Present Service Rifle.

In the center is shown the Garand semiautomatic rifle and, below, the Pederson. Both are caliber .276 and will be entered by the Ordnance Department in the forthcoming competitive tests. Above, for comparison, is shown the U. S. service rifle.

clude the possibility of injury to the firer due to premature unlocking. The firing mechanism should be so designed that the firing pin is controlled by the trigger and sear direct, that is, the bolt mechanism should move forward to the locking, or firing position, with the firing pin under the control of the trigger and sear mechanism, so that the cartridge is not ignited until the trigger is pulled to release the firing pin. The bolt, or block, should remain open when the last cartridge in the magazine has been fired. In case a detachable magazine is used it should be possible to insert a new magazine with the bolt in either open or closed position.



Caliber .30 and .276 Ammunition.

On the left is shown the caliber .30 M 1 bullet (172 grains) and the round of caliber .30 ammunition. On the right is the caliber .276 experimental, taper base, bullet (125 grains) and the caliber .276 round.

f. The trigger pull, measured at the middle point of the bow of the trigger, should be not less than 3 or more than 5 pounds. The trigger action should be similar to that of the present service rifles, that is, it should have a light first pull, after which there should be no appreciable backward motion until the sear is released.

g. An efficient safety or locking device must be provided, permitting the rifle to be carried cocked and with cartridge in chamber without danger. The rifle should remain cocked and ready for firing when the safety device is unlocked.

h. The weight of the rifle, with magazine empty and without bayonet or sling, should be a minimum consistent with proper functioning and in no case should exceed 8.75 pounds.

i. The rifle must be so designed as to give good balance and be adapted to shoulder firing.

j. The rifle is to be strictly semiautomatic; that is, a self-loading type, and is not to function as an automatic rifle. The trigger mechanism should be so designed that it will be impossible to fire more than one shot with each pull of the trigger; the trigger must be released and pulled again for each successive shot.

k. The accuracy of the rifle should be comparable with that of the present service shoulder rifle using M 1906 ammunition.

l. The stock should be so designed, if practicable, as to allow ventilation of the gun without charring or overheating the wood.

m. The rifle should be capable of being used as a hand-functioning arm in case the self-loading feature is disabled. The bayonet should be so attached as not to interfere with the proper operation of the piece under any conditions that may normally be expected.

THE following features are considered desirable: *a*. The use of special high-grade material, highly specialized heat treatment, or special-grade machine work or finish in general should not be required.

b. The use of special oil or grease or any other material not readily obtainable in the field should not be necessary to the proper functioning of the piece.

c. The use of special tools for adjustment or dismounting or assembling should be reduced to the minimum.

d. Sights should be over the center of the bore and so firmly fixed as to avoid any possibility of variation in position due to constant firing or rough handling.

e. The rear sight should be not less than 2½ inches and not more than 6 inches from the eye when using the weapon in the prone position. It should be graduated up to 1,000 yards and have a windage adjustment, equivalent to that on the sight of U. S. rifle caliber .30 M1903.

f. In case a sight embodying the above points is not devised by the designer, the rifle should be so constructed as to permit the installation of such a sight.

All rifles submitted will be subjected to prescribed tests by a board of officers at a place to be designated by proper authority.

During trials the rifle will be entirely in the hands of the board. If the rifle fails in any test the remainder of the program may be discontinued, or, in the discretion of the board, the inventor may withdraw the rifle for such repairs or alterations as he may desire to make, after which he may again submit the rifle to the board and the test will be continued.

The Government will provide ammunition necessary for official tests.

It must be thoroughly understood that the Government is not bound to adopt any rifle under the conditions of this test.

Subsidized Motor Vehicles in England

DURING recent debate in the House of Commons, London, the Secretary of State for War said that it was not considered necessary to offer any subsidy for suitable passenger road vehicles of approved design which might be of use with the army on mobilization. Information was being obtained as to the number of mechanical transport vehicles in the country of a kind suitable for Army requirements. The number of such vehicles which might be subsidized under the present scheme is limited to 1,000 and this number is at present enrolled. The regulations, which are constantly under review, are so framed as to secure that the most up-to-date vehicles can be relied upon, and that the examination and periodical inspection shall not unduly interfere with the normal operation of the vehicles.

The Secretary said that 484 vehicles were subsidized in 1928 in replacement of a similar number which had ceased to be eligible. The subsidy is £40 a year in each case and the total payments made since the beginning of the scheme in January, 1924, until the end of January, 1929, have amounted to approximately £147,000.

Educational Orders for Munitions

The Facts of the Case as Presented to Congress

Part II: Statement of Frederick J. Haynes*

WE continue in this issue publication of statements of leading American manufacturers before the Committee on Military Affairs, U. S. House of Representatives, 70th Congress, 2nd Session, on a Bill (H. R. 450) to provide for Educational Orders to Manufacturers by the War Department. The hearings before the Committee began January 11, 1929.

Educational orders are such a vital part of our Industrial Preparedness plans and the statements in their favor are so convincing that, in the opinion of the Editors, the matters presented at the hearings warrant the fullest consideration. To this end the principal statements before the Committee are published serially in these pages.

THE EDITORS.

DURING the last war I was manager of production of Dodge Bros. and later chairman of the board.

In October, 1917, we were approached to make a recuperator. We said, "What is a recuperator?" We had no idea what it was. It was then explained to us that there are really three parts to a gun, the carriage, the recuperator, and the barrel. The carriage carries the recuperator, and on the recuperator is placed the gun barrel, and the object of the recuperator is to absorb the shock of the gun after the discharge and return it to its original position ready to fire, without having destroyed the aim or the range.

After we got that explanation we said, "Can we see a sample?" No; they had no sample. Then, we were informed that it was complicated, that even the French were confident that were any of these recuperators to be captured by the Germans it would be impossible for them to duplicate the mechanism.

Then the only thing that we had to fall back on was the fact that we had been asked to produce them. Obviously the country needed them, and so we took a chance and said we would produce them, purely and absolutely with no knowledge whatsoever, excepting that if they had been made by man before, they ought to be able to be made by man now. That was the way we started to produce, gentlemen. That was all the information we had on which to start to produce one of the vital mechanisms of the war which was needed, and for which our men were suffering because of their lack.

WE ASKED for assembly drawings that we might get an idea of the picture. But there wasn't even an assembly drawing. There were the parts drawings, but no drawing showing these parts put together in the relation in which they were to function. So we started with no knowledge whatsoever. We had no education. We had never seen the thing before. We did not know what a recuperator meant until it was explained to us.

Then we found, after we began to look the thing over, that it was complicated; that to start with and make the rough recuperator we had to have a billet of steel 7 feet long and 27 inches wide and 18 inches thick, weighing somewhere in the neighborhood of 10,000 pounds; that you had to cut 7,500 pounds of chips off that block of steel, and when you got through you had that block of steel with holes running through it in most every direction, with trunnions on it. Then in those holes you fitted pistons and hollow piston rods and piston rods inside of those; you had bores in there with at least 30 different tapers on them.

You had machine requirements there that we had no machines at all to meet. In fact, as we got into the job we found that the first thing we needed was a building, and we figured as nearly as we could that it would take approximately 11 acres of floor space. Then we tried to get a contractor to put that building up for us so that we would have one section of it in two months' time. We were approached about the middle of October, and about the 1st of November the contract was awarded us, and we started to put the building up ourselves, because the contractor said the building could not be put up in the time we wanted it. We wanted one section to be ready to begin to do the rough planer work on billets, and we said we would be ready by the 1st of January. Well, we weren't. We were ready on the 4th.

THEN we found, at the time we started the building, that we had no machine tools at all to begin the job, and it was necessary for us to design and make at least 200 different machines before we could begin.

Then when we were finally ready to do the rough work for which we had planers, or had accumulated planers, we found the steel companies had not been educated. The steel companies were not able to produce these billets, 8 feet long, that I told you about, with the required physical and chemical specifications. Consequently, after we were ready to begin the rough work, we waited between two and three months while the steel companies had to educate themselves in order to make the billets so that we could even begin to start on the first operation.

War had been declared in April and the following March we were able to get our first billets, nearly a year later. The latter part of July, or, approximately, the 1st of August, 1918, we produced our first recuperator of the howitzer type, which was the smaller type. It was not

*Vice-chairman of the Committee on National Defense of the United States Chamber of Commerce; member of the Chamber's Board of Directors; former Chairman of Dodge Bros., Detroit; during the World War manager of production, Dodge Bros.

until October, 1918, that we produced the first rifle type. Then in November came the Armistice. Between July, 1918, when we produced the first howitzer, and July, 1919, after the war had closed, when we were once in production, we were producing recuperators at approximately a rate of 45 a day.

We produced a total of 1,601 howitzer and 881 rifle, but had we been educated, had we not had to have explained to us what a recuperator was, had we even the faintest idea what it was, then we would have been able to start, but we ran into difficulties because of lack of education everywhere. The materials specified for the construction of that gun were of such an exacting nature that the manufacturers were not accustomed to make them. For instance, there were bronzes specified that as you looked at them you would think the foundries would be capable of producing, but when they began to produce them they ran into the fact that there were strange stresses and strains; there were shrinks. The metal did not work the way it should work. Consequently they had to cut and try, cut and try, until finally they overcame the difficulties.

In other words, they got their education, and after they got their education then they were able to begin to produce.

NOW, had a system such as you are contemplating in these educational orders been in operation, the War Department would not of necessity have had to lose the time from April to October to place that order.

In that great time of stress when everybody was doing the very best they could, and working at the utmost pressure in order to get things done as quickly as possible, they had an idea that maybe one part could be made in one plant, another plant could make this part, and so on, and then assemble them and save time. That was the plan the Government went on in trying to produce these recuperators, and they found it was so complicated and so exacting that such a thing would be utterly impossible, because the parts wouldn't fit. So, it was practically from July to October that was lost, because even the Government itself was not acquainted with that fact, due to the fact that up to that time there had never been one of these recuperator mechanisms manufactured in this country.

So we did not have any education. We started from a dead start, just like a boy who has not learned his a b c's, and all the time our men were over there at the front, and they were going over there, and they were hoping desperately that we would get them something, and we were doing our best, but we did not have any idea what we were trying to do until we got our education.

Had we been permitted to have gotten acquainted with the recuperator, had we been told that some day we might be called upon to make them, we would have made a few. We would have gotten a set of tools and a set of gauges, and we would have gotten a splendid idea of what we had to do.

For instance, the bores in that mechanism were of an exact diameter. They had to be so smooth, in order that the packing which was necessary to hold the high pressure should not be destroyed, but would last and be permanent, that they must resemble in appearance, as you looked through them, the finest mirror that you ever gazed on. There must not be any scratches, because if there was a scratch, every time that packing slid back and forth over it, it would begin to destroy itself.

We worked for about two months on just the simple thing of trying to find a suitable polishing solution that would smooth that bore to the exactness desired and leave no scratch. It took us two months to discover the right grit and the right lubricant, the proper mixtures to do that apparently simple thing. And yet I presume anybody would be justified in saying that it is a simple thing to polish a bore.

That is simply a recital of the difficulties we faced. We started in October, 1917, and we did not produce our first one until the next July. We did not practically get into quantity production on the one gun until along in October, 1918, or a year from then, and on the rifle we never got into production in quantity until along in January of 1919.

HAD the manufacturers of this country been educated and knew as much about making the raw parts—that is, assuming that we had all been educated and we had the knowledge—then the billets would have begun to flow in as we began to ask for this other material. Or, if there was knowledge and information available as to the peculiarities and the action of these things in the files of these other companies, we would have got our materials quicker. Everyone would not have greeted us with a look of blank amazement as to what we wanted, and then, too, the War Department would have been acquainted with the difficulties of that mechanism. By means of these educational orders they would have known the size and the magnitude of the job. They would have selected, then, a company that had the resources and the facilities to handle that large job. No time would have been lost there. If they had started to place it in July, it would have been placed in July, and the latter part of 1917, even with one set of tools, we would have begun the production—not quantity production, but in the meantime we would have been making additional tools, because we would have known something about them.

THERE is no money in educational orders for the manufacturer. But we owe everything we have got to this country. Whether we agree with everything we have here or not, I don't know of any better country to live in. And the manufacturers as a class would be willing and glad to help and coöperate with the authorities at Washington toward the end that we might better preserve this country in time of need, and it is my own private opinion—this is not official, nor have I the experience upon which to base this opinion—but purely as a layman it is my opinion that valuable as time has been in the past, in the last Great War, when we practically, as has been stated here, did not ship anything abroad, in the new war, if it should come, time is going to be more valuable, perhaps even as the square or the cube. I would say two years to-day may then in effect be four years or eight years.

We are all of us for peace, and I know of no better way to get it than through education and by being ready; and it will take some money to get these manufacturers ready—to educate them. But when we are ready and when we are prepared, then we are going to be very peaceful, because nobody will want to attack us, and, of course, we want nobody to attack us. But we do believe in education.

Henry C. Osborn

Recently Appointed Chief of the Cleveland Ordnance District

A ZEALOUS exponent of industrial preparedness, Mr. Osborn was appointed Chief of the Cleveland Ordnance District, November 22, 1928, succeeding Frank A. Scott. Prior to his appointment he was associated with the district as Chief of the Ammunition Division. During the World War he rendered outstanding service when The American Multigraph Company, of which he is head, promptly undertook and successfully carried on the production of fuzes for artillery ammunition.

In addition to being President of The American Multigraph Company, Mr. Osborn also is vice-president of the Electric Smelting and Aluminum Company of Cleveland, a director of the National Better Business Bureau, and a director of the Cleveland Better Business Bureau, from which he is retiring as president, having held that office for the past three and a half years, a director of the Cleveland Morris Plan Bank and a former vice-president of the Cleveland Chamber of Commerce.

Preservation of Ammunition

Deterioration of Existing War Reserve Stocks

By D. C. Hall*

PRESERVATION of ammunition is a new term which has come into general use in the past few years. It has not been defined to the satisfaction of all who use it, but in the Ordnance Department it means to keep in safety, to prolong the life of, to maintain in serviceable condition, and to bring back to a condition of serviceability when unfit for use, existing stocks of ammunition. From this definition, it will be noted that preservation of ammunition includes among other things surveillance, ballistic tests, maintenance and renovation. Since it will be impossible to consider thoroughly these various subjects in one article of limited length, this paper will simply discuss the existing stocks of ammunition, and the deterioration which has taken place. Later articles will discuss the subjects mentioned above and the various measures that must be taken to keep ammunition in safety and to maintain it so that the existing stocks will always be serviceable and ready for use.

Fig. 1. Corrosion of Trench Mortar Shell Caused by Nitro-Starch Explosive Filler.

PRIOR to 1920 only a comparatively small reserve of ammunition was maintained and the difficulties and costs of maintaining such a reserve were not great as it was periodically renewed during the serviceable life of the ammunition with new ammunition manufactured to replace that expended in target practice and other authorized firing tests. The comparatively simple manner in which this reserve was maintained created a general impression that ammunition was not perishable and that the creation of a reserve of ammunition simply meant the manufacture of the required amount of ammunition and the provision of suitable storage facilities where it could be kept until needed. The problems which have arisen in connection with the preservation of the existing stocks of ammunition have demonstrated quite conclusively that ammunition is perishable and that it has but a limited life, unless it is periodically inspected, tested, and reconditioned or renovated when signs of deterioration appear. The smokeless powder and explosives, such as TNT and amatol, which are contained in loaded ammunition, are chemicals which will not remain stable indefinitely and metal components such as shell, adapters and boosters, fuzes, cartridge cases, etc., soon rust or corrode unless they are covered effectively with protective coatings. It has been estimated that the average serviceable life of small arms ammunition is approximately ten years and that of artillery ammunition twenty years. There are serviceable stocks of small arms ammunition on hand which are over ten years old and there is some smokeless powder still in service which is over twenty-five years old. But some of this same small arms ammunition became unserviceable before it was ten years old and powder is now being salvaged which is less than fifteen years old, so that the average serviceable life as given above is not likely to be exceeded unless there are marked advances in the present art of manufacturing ammunition.

Fig. 2. Corrosion of Bomb Body Caused by Explosive Filler.

The preservation of the existing stocks of ammunition is probably more difficult and more expensive than normally would be the case because a very large part of the existing stocks was manufactured during the World War and was subjected to unusual handling and storage conditions. During the war it was necessary to produce great quantities of ammunition in an extremely limited period of time and in order to do this changes had to be made in specifications, and raw materials and explosives which had not been extensively used in this country, prior to the war, had to be adopted and used. Prior to 1917 practically all smokeless powder manufactured for the U. S. Army was air dried, but in 1917 the specifications were changed to permit water drying, which greatly reduces the time required to manufacture and deliver smokeless powder. An example of an explosive which was adopted and used during the war as a bursting charge in a considerable number of shell is 80-20 amatol (a mechanical mixture of ammonium nitrate and TNT in the approximate proportions of 80-20). In addition to these changes in specifications and the adoption and use of new raw materials and explosives, consideration must also be given to the fact that ammunition manufactured during the World War was produced for immediate use and those refinements of manufacture which may be required reasonably in ammunition, which is to be stored as a reserve, were not emphasized and insisted upon. Many lots of ammunition, which failed to meet the specifications, were accepted during the war because of the great demand and no sensible reason existed for rejecting ammunition which could be fired even though it could not be stored for long periods of time. The following example is not an

*Ordnance Field Service, Office of the Chief of Ordnance, Washington, D. C. Captain, Ordnance Department, U. S. Army.

instance of such a defect, but is simply illustrative of a war-time practice which has made the problem of preserving the existing stocks a more difficult and expensive one. During the war large quantities of small arms powders were packed in metal drums instead of the standard smokeless powder boxes. These drums were quite suitable for transportation and limited periods of storage, but in 1920, soon after these small arms powders were permanently stored, the drums began to deteriorate rapidly and to develop leaks which contributed to the rapid decomposition of the powder contained therein, with the result that several fires occurred and eventually all of the powders in these metal containers had to be repacked in standard smokeless powder boxes. With respect to the unusual handling and storage conditions to which the existing stocks of war time ammunition were subjected, it is to be noted that large quantities of this ammunition were shipped abroad and then returned to this country at the close of the war and, further, that there was an acute shortage of storage facilities in 1920, with the result that some of the existing stocks were temporarily stored in the open to avoid demurrage charges and for other reasons. These unusual handling and storage conditions are to be expected in war time and have no bad effect where the ammunition is soon expended, but ammunition, intended for reserve, cannot be subjected to such conditions without some impairment of its keeping qualities.

Fig. 3. Bombs Ruptured by Gases Generated by Deteriorated Explosive Fillers.

The unusual conditions under which a large part of the existing stocks were manufactured and the unusual handling and storage conditions to which they were subjected are not listed as the causes of the deterioration which has taken place, but in many instances they did undoubtedly accelerate it. It has been stated above that ammunition, even that manufactured under the best possible conditions, will not last indefinitely, and so it is reasonable to expect that the existing stocks of war-time ammunition, which are now over ten years old and which have not been periodically replaced by new ammunition, will show marked signs of deterioration. Logically, this might be expected not only in the small arms calibers but also in fixed artillery ammunition and propelling charges for larger calibers as well.

PROBABLY the most serious deterioration that has taken place in existing stocks of ammunition is that of smokeless powder. The stocks of bulk powder, of small arms ammunition (cal. .30 ball, model 1906), of fixed artillery ammunition (37-mm. to 4.7-inch) and of propelling charges for separate-loading ammunition all have been affected. Considerable quantities of small arms ammunition have been salvaged, a large number of rounds of fixed ammunition have been disassembled and stored as components because of powder deterioration, and although only a very limited quantity of bulk powder and a limited number of charges for separate-loading ammunition have become totally unserviceable, signs of deterioration are present. The deterioration of the powders for small arms ammunition is not considered to be unusual, for experience shows that small grain powders, such as cal. .30 Pyro D. G. W. (i. e., diphenlamine-graphited-water dried) can not be expected to have an average serviceable life much greater than ten years. The deterioration of the powder for calibers such as 2.95-inch and 75-mm., however, seems to be unusual, although, possibly, it might have been anticipated that powders manufactured under war conditions would not keep as well as those manufactured in times of peace. It is a fact, however, that the powders for 37-mm., 3-inch field gun, 3-inch antiaircraft and 4.7-inch field gun ammunition have not deteriorated at nearly as rapid a rate as the powder for 75-mm. and 2.95-inch ammunition. The deterioration of 75-mm. powder seems to be unusual because it first appears as a spot of orange or yellow discoloration which soon spreads and affects the entire grain. When first detected the number of deteriorating grains in a box or charge is small, but during experiments made with bulk powder to determine the rate of deterioration it has been found that deterioration is so rapid that spontaneous ignition of the powder has occurred within three years after the first deteriorating grains were discovered. However, in small arms ammunition and in fixed ammunition where the amount of powder involved is comparatively small, deterioration has not been nearly as rapid as in bulk powder and most of this ammunition remains serviceable for a considerable period of time after deterioration is first discovered. Small arms

ammunition is being used which contains powder that has given a 65.5°C. test as low as five days, and in the case of 75-mm. ammunition no marked drop in velocity or pressure occurs until the percentage of deteriorating grains in the charge approaches ten per cent. This powder deterioration is not confined to powders manufactured by certain companies but is present in most water-dried powders. Since the greater part of the existing stocks of ammunition contain water-dried powder, most of this powder must be replaced within the next few years.

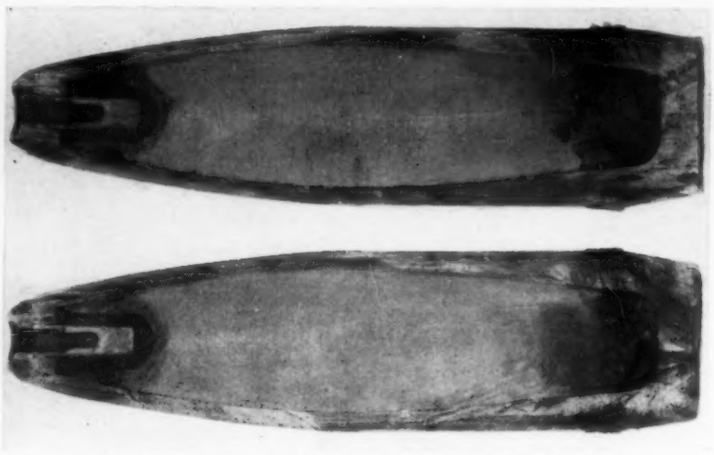


Fig. 4. Defective Loading of 80-20 Amatol is Believed to be the Cause of the Relatively Large Number of Prematures.

WITH deteriorating powder the question of safety is, of course, a most important one and in addition to the usual surveillance and ballistic tests which are being conducted a number of tests have been made to determine whether the powder in small arms ammunition and fixed artillery ammunition is liable to ignite as it deteriorates and thus become a serious menace in storage. In one experiment conducted with small arms ammunition which contained deteriorating powder several boxes of the ammunition, packed in cartons and bandoleers, were stored continuously at a temperature of 50°C. and observations were made from time to time of the rise in temperature in a box of ammunition and the condition of the powder. The experiment showed that as the powder deteriorated the temperature rose a few degrees above the temperature of the magazine and then subsided until, upon completion of the test, it was found that the powder had become an inert gummy mass. At no time during the test was a temperature reached which was high enough to scorch or brown the paper cartons or cloth bandoleers in which the ammunition was packed. Similar experiments are now being conducted with fixed 75-mm. ammunition in boxes and fiber containers, and although the experiment has not proceeded far enough to permit definite conclusions to be drawn it seems likely that the heat generated as the powder decomposes will be dissipated rapidly and that eventually the powder will become inert. With respect to bulk powder and separate-loading propelling charges, however, the situation is quite different and to guard against fires it has been necessary recently to adopt a system of inspecting each box of bulk powder and each container of propelling charges for signs of dangerous deterioration. The tests have not been completely developed, but probably will consist of inserting a strip of tenth-normal methyl violet paper in the atmosphere above the powder or propelling charges in a container and exposing it to the action of the fumes in the box or container for a period of 24 or 48 hours. Preliminary experiments indicate that such a test will reveal any marked deterioration of the powder which is liable to become dangerous within the next few months.

SOME of the explosives which are used as bursting charges for shell and bombs have deteriorated or changed. A nitro-starch explosive used in 3-inch trench mortar shell caused serious corrosion of the projectile, and in one instance pressures were generated, which caused the shell to rupture and a serious fire and explosion occurred before this ammunition could be salvaged. All stocks of 3-inch trench mortar shell loaded with this explosive were salvaged several years ago. The explosives used in bombs have also deteriorated and some bombs became unserviceable before they could be used. Some of these explosives caused a serious corrosion of the bomb (see Fig. 2), and some generated pressures which caused the bombs to rupture. (See Fig. 3.) Some shell loaded with TNT and 50-50 amatol began to exude an oily brown liquid soon after they were placed in storage and this exudation increased as the shell remained in storage, particularly at places such as Charleston, S. C., San Antonio, Texas, and in the foreign possessions where the average temperatures are higher than at depots located north of the Mason and Dixon's line. A large amount of research and investigative work has been done to determine the causes of exudation. A fact which has been developed is that exudation usually occurs in shell where alcohol is present in the shellac which was used to coat the booster cavity. The effects of exudation also have been investigated and a number of exuding shell have been sectionalized and examined, but in general no defects have been discovered which might possibly make the shell dangerous to fire. Firing tests also have been conducted with exuding shell which indicate that the sensitiveness and power of the bursting charge is not seriously affected. Exuding shell which have been deboostered and cleaned to remove all exudate from the booster cavity and threads in nose (which might possibly cause a premature or setback) function fully as well as shells which have not shown signs of exudation. Therefore, it appears that exudation is not nearly as serious as it was thought to be when it was first discovered and that most shell which are exuding can be readily made serviceable by deboostering, removing the exudate from the booster cavity and threads in the nose; and reassembly with serviceable boosters. Preliminary renovation operations, now being carried on at the Delaware Renovation Plant, indicate that less than 3 per cent of the exuding 75-mm. shell examined will require a replacement of the shell charge.

The defects which exist in the stocks of shell loaded with 80-20 amatol and smoke mixture are most serious because of the comparatively large number of shell which are loaded with this explosive and the relatively large number of prematures which have occurred during firing tests. Shell which have been sectionalized at Picatinny Arsenal

show very clearly defects in loading which are believed to account for the prematures which have occurred. This defect is in no way due to deterioration, because shell loaded with 80-20 amatol have shown practically no signs of deterioration during the ten years they have been in storage and they do not exude when they are stored in the tropics. The fact, however, that a large number of existing shell have loading defects represents a deterioration of the reserve, for these shell cannot be classed as serviceable until they have been unloaded and reloaded.

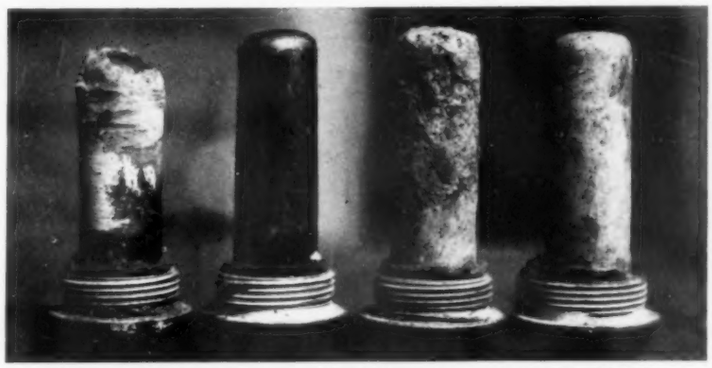


Fig. 5. Boosters for 75-mm. Shell Corroded by Contact with the Ammonium Nitrate of Amatol.

SEASON cracking of brass cartridge cases and fuze parts is a form of deterioration which has affected a considerable portion of the existing stocks, particularly the stocks of small arms ammunition. It is noticeable in brass cartridge cases for artillery ammunition and in fuze parts such as the lower detonator cup for Mk. III, IV, and V, point-detonating fuzes, but only a very limited number of such components has thus far been affected. In small arms ammunition, however, this defect developed within a short time, increased very rapidly for a period of two or three years, and then gradually ceased as the stocks aged. It is now practicable to cull the defective cartridges from a lot of small arms ammunition and return the good cartridges to storage with every assurance that but few will develop season cracks as the ammunition grows older. It has been estimated that from 10 to 25 per cent of the cartridges of war-time manufacture contain this defect and those with this defect must be classed as unserviceable. This defect, which usually appears as a fine crack at the mouth of the cartridge case, permits the bullets to become loose, exposes the powder to the air, and usually causes the ammunition to malfunction when fired. This defect or deterioration appears to be one which should be eliminated readily from future stocks of ammunition as it is believed to be due to unsuitable raw material or manufacturing methods which can be corrected.

A considerable portion of the existing stocks of loaded fuzes show marked signs of deterioration, or have loading or assembling defects which cause frequent malfunctions. There is some indication that the fulminate detonators in Mark III, IV, and V, point-detonating fuzes have deteriorated, but in general these fuzes still function in a satisfactory manner when loading defects are not present. A considerable number of firing tests made with Mk. IV and V fuzes have revealed serious loading or assembly defects such as failure to arm, failure of delay elements to burn, etc. These defects are most noticeable, of course, when the angle of fall is small or there is a light or glancing impact. An investigation of numerous failures which occurred with Mk. V point-detonating fuzes revealed the fact that these occurred when the fuzes were fired for impact on hard or rocky ground which caused the head to crush before the fuze could function. Time fuzes such as the 21 sec. and 45 sec. combination time and percussion fuzes have also shown marked signs of deterioration. Practically all of these fuzes are discolored or corroded, but only a very limited number has been so badly affected by deterioration that they cannot be used. Most of these fuzes, when fired with a setting of 15 seconds, show but little greater dispersion in time of burning than when they were manufactured, but it is noticeable in periodic firing tests that this dispersion grows slightly greater each year which indicates that they will have but a limited period of serviceability and eventually will have to be replaced.

CORROSION and rust have also caused serious deterioration of the existing stocks of ammunition. Metal components of ammunition have been adversely affected and also small arms cartridges. In the case of metal components it is invariably due to the absence of a suitable protective coating, or to the breakdown of the protective coating which was applied in 1920 when the material was reconditioned for permanent storage. Certain kinds of lead-free paints of very poor quality have broken down completely and many shell are now rusty which would have shown no signs of deterioration had they been coated with two coats of red lead paint or a similarly effective covering. Zinc plating has been most disappointing as a protective coating for adapters and boosters and other similar parts, and in many instances it has been noted that ordinary lacquer or shellac has proved far more effective than zinc plating. Small arms ammunition exposed to moisture and dampness will corrode, and much of the small arms ammunition shipped overseas and then returned to this country has corroded probably because of leaks which developed in the metal liners in which it is packed.

The above description of the present condition of the existing stocks of ammunition, no doubt, presents a very dark picture and probably creates a doubt in the minds of many as to the value of these stocks. Fortunately, however, most of the defects and deterioration which have been discussed above can be corrected and the existing stocks of ammunition can be maintained in serviceable condition at but a fraction of their original cost. Seventy-five millimeter ammunition, which is totally unserviceable because of deteriorating powder, can be renovated and made practically new by a replacement of the propelling charge. It seems essential, however, to emphasize the deterioration and defects which exist, in order that the problems of preserving ammunition without periodic turnover and replacement may be realized and the necessity for funds to carry on this work may be appreciated.

ARMY ORDNANCE

Published Bimonthly by
THE ARMY ORDNANCE ASSOCIATION
WASHINGTON, D. C.

MAY-JUNE, 1929

Month by Month

THE vast system in operation for supplying Army munitions to the consumer is an extremely important part of our defense agencies. Someone has remarked that the whole question of ordnance manufacture and supply, being devoid of the usual pomp and glamor of other military activities, comes in for less glory in the public mind even though such a function is second to none other in importance. But if we mention the lack of gold lace in the munitions game we might go further and distinguish between the two great ordnance functions. On the one hand is the design, development and manufacture of munitions; on the other, routine procedure of getting the manufactured articles into the hands of the "customers," servicing them while there, keeping the thousand and one spare parts in stock ready at beck and call, and even overcoming "sales resistance." Of these two major functions we refuse to concede that the latter in any way is less important than the former. True, supply may smack more of the mail order business or the service station complex than does the new design spread on the drawing board and changed and tampered with through every phase of experimentation until the satisfactory completed article is turned out. But unless the supply organization is in existence, functioning with precision and ready to expand to meet any requirement, the best munitions in the world aren't worth so much scrap metal. The analogy is in the same degree were we to merchandise automobiles or airplanes or radio sets or whatnot without first having them in the warehouses when and as wanted with A No. 1 service at hand to keep them fit and their owners and users satisfied.

Merchandising Munitions

This, if you please, is what we refer to when we say merchandising munitions. Ordnance—from the mineral and chemical in the earth, through every phase of design and production until it is delivered and serviced in the hands of troops at Army camps and stations in peace and on the firing line in war—has every analogy to civilian industrial operation. Ordnance Field Service, whose duty it is to perform this vital function, has its far flung system of depots throughout the length and breadth of the land and beyond. It strives to satisfy its customers in every detail giving them what they want, when and where they want it. A big job most certainly. And every bit as important as any other phase of ordnance preparedness. Merchandising munitions goes hand in hand with manufacturing munitions.

In the belief that illustration is always an aid to the better visualization of fact and theory, we are pleased to have the opportunity of publishing, in connection with General Hof's article in this issue, a graphic chart showing the many steps through which ordnance passes from its earliest stages of manufacture to its final delivery at the battle front. The chart presents, in the words of the hawker at the opera, "the complete story, words and music." Having studied it there is little room to doubt the immensity of the task which embraces every field of engineering and every classification of management. Of the myriad operations involved the zenith is not reached until the moment of delivery of efficient, serviceable equipment at the fighting line. If the material delivered there can not perform its appointed task then the entire machinery from the very start is criminal waste, and, as a corallary, if the equipment is efficient but the supply organization is slow and cumbersome or otherwise inefficient, then the situation is equally tragic. The system from A to Z must be fool proof. The story is told of a chief of one of the supply branches of the Army who spent years of effort in successfully organizing his department when to his dismay along came the Spanish-American War and ruined it all. Happily for America, both the design and manufacture as well as the supply phases of ordnance are highly efficient, not only for the peacetime functions of the Army but also for the demands of war which all real patriots hope will never come.

NO exponent of industrial preparedness was more helpful in the work of the Army Ordnance Association than Professor Alexander Lewis Jenkins whose death in Cincinnati, March 8, 1929, leaves a vacancy in our ranks which will be difficult to fill. Professor Jenkins was a member of the Board of Directors of the Cincinnati Post, A. O. A., head of the Mechanical Engineering Department at the University of Cincinnati, and a major in the Ordnance Reserve assigned to the Cincinnati Ordnance District. During the World War he was in charge of the training of large numbers of the National Army in the Students' Army Training Corps, University of Cincinnati, and later was instrumental in the establishment of the R. O. T. C. at the same institution. He was known throughout America and Europe for his research in the design of machine tools and heavy machinery. His publications on the analysis of combined stresses and their application to the practical design of machine tools, hydraulic presses, punching and shearing machinery are widely quoted in textbooks and engineering literature. It was his aim during 24 years of service at the University of Cincinnati to develop methods of teaching and courses of instruction in mechanical engineering subjects which were adapted to the coöperative plan of education.

Alexander Lewis Jenkins

To the formal expression of sympathy adopted by the Executive Committee of the Cincinnati Post, ARMY ORD-

NANCE adds this word of appreciation and praise. In offering our condolences to the officers and members of the Post and to the family and friends of Professor Jenkins, we join with them in mourning the death of a learned man, an active coworker and a real exponent of adequate national defense.

A Short-Sighted Policy

SEVERAL years ago Col. W. W. Coleman, Ord. Res., President of the Bucyrus-Erie Company, South Milwaukee, Wis., conceived the very excellent idea of forming among the personnel of his organization a complete reserve ordnance maintenance company, the reserve officers to be drawn from the executives of his concern and reserve enlisted men from among the machinists and other engineering talent in his employ. Such a company was formed and is in existence. A novel plan and fraught with tremendous possibilities. One can envisage many of our larger manufacturing concerns with such self-contained units. Trained periodically in the work of a maintenance company, these nuclei would be ready in the event of an emergency to step into their military tasks without delay and with little other preliminary training.

Unfortunately the plan has not been successful for the reason that the reserve officers comprising the outfit are trained individually while as yet no training whatever has been available for the reserve enlisted men, to say nothing of joint training where the company could simulate its wartime status and practice as a unit.

Once again the old bromide "no funds" is the stumbling block. Train the reserve officers assigned the company occasionally here and there, yes, but there is no provision, so we are told, for the reserve enlisted men and consequently no possibility of all training in their wartime functions together. Such a condition, in our opinion, is regrettable and is the result of an extremely short-sighted policy. Granted the value of the plan, either we are going to foster such units in our manufacturing companies or we are not. If so, let's make it possible for Colonel Coleman and other public-spirited men like him to have live, active, well-trained companies in their commercial establishments. If not, let us say candidly that with our millions of surplus in the Treasury we are too bent upon drying up the wet spots—flood relief is not referred to even indirectly—on our much spotted map, too much concerned with eradicating corn borers, protecting migratory birds, investigating investigators, etc., etc., to allot even the pittance required to make so important a defense matter an actuality.

The Ordnance Department, we are told, and as we should expect, is heartily in favor of the Coleman plan, but as in other similar matters, its hands are tied. Meanwhile, for want of at least some slight encouragement from those who control the purse strings it looks as though interested ordnance enlisted personnel in our civilian plants must play their war games on paper, fall asleep over such thrilling, breath-taking maneuvers, and awake only to have forgotten them entirely. In our opinion the Coleman plan would cost not an additional penny. All that would be necessary would be the authorization that some small portion of the funds available for reserve officer training be utilized for the training of reserve enlisted men. But, alas, so simple a solution is all too complicated.

Violet Rays For Guns

THOSE of us who are accustomed to take on our winter coat of tan under the ray lamp in a man-made solarium may register surprise at learning that the Ordnance Department in its relentless antirust crusade has turned to synthetic sunlight for keeping our war reserve guns in fighting trim. Colonel King, in an accompanying article, describes this and other investigations conducted under his direction at the Rock Island Arsenal.

Keeping our war reserves rustless is a problem which has baffled experts for many a year. Unlike the ancient monarch who put on his spectacles and beheld moth and rust eating away at everything before him, one needs no such magic to detect the constant deterioration going on in our munitions storehouses. Despite constant vigilance and thorough precautionary measures, the endless battle against deterioration continues. That it is more than a matter of paint and grease is at once evident. Indeed, in many cases the infinitesimal quantities of moisture in such substances or even the moisture in the air at the time of application is sufficient to give corrosion a foothold and eventually to cause untold damage.

Hence we can see how any method which might tend to overcome rust is worthy of trial. Who knows but that the day is not far distant when old man howitzer will be taking his sun bath along with the other big guns—the one to eradicate rust from his recuperator, the others to grow hair on a bald pate or give suppleness to muscles that have lost perfect timing in the golf stroke. This much is certain: both classes must be kept in perfect condition. If the ultra-violet ray will do for our guns what it is doing for spry, dapper old friends who grow younger with the passing years then to Colonel King in his novel experiment success aplenty.

Things Worth Debating

WE take this means to assure all members of the Army Ordnance Association that the pages of this Journal always are open to constructive discussion of any and all matters relating to munitions preparedness. Indeed, we believe that no better method is available for the certain advancement of American munitions than a full exchange of constructive ideas. In his excellent article on Mechanization in the last issue of ARMY ORDNANCE, General Williams took occasion to request readers to submit suggestions for improvement in the development of automotive ordnance in the Army as it has progressed to date. We second the General's invitation and broaden it.

And the Editors pledge that they will not be bound by the orthodox. For, after all, what is orthodox today? If one worships orthodoxy how account for the fact that Doctor Wood, one of the five American physicists ever to be admitted to the Royal Society of England, produced the invisible searchlight of the World War? Or that Doctor Rogers announced the theory that static and interference could be eliminated by taking the aërial out of the air and—of all places—burying it in the ground? Or that Major Hoar's proof that to regard the earth as flat allows of less error in exterior ballistics than to regard it as curved? No, it is not for us to pass judgment but rather to spread enlightenment that in the end the national defense may profit. Gentlemen, the pages are open. What do you say?

The Spruance Endowment

An Editorial

AS announced elsewhere in this issue, the Army Ordnance Association is the recipient of an endowment from William C. Spruance of Wilmington, Delaware, a vice-president of the Association, providing in perpetuity for the establishment at the Engineering School of Princeton University of ten annual memberships in the Association, five of which shall be full memberships to include the dean and four of his teaching staff to be nominated by him annually, and five student memberships for members of the senior class to be similarly selected annually. All nominations are to be subject to the Association's requirements as regards eligibility. The endowment will become effective with the scholastic year 1929-1930.

Thus is established a most potent method of keeping one of our engineering educational institutions in constant touch with munitions affairs and of familiarizing a nucleus of its student body with the importance of industrial preparedness and with the requirements and developments of ordnance. Formal acknowledgments have been made to Colonel Spruance by the officers of the Association for his magnanimous and far-reaching gift. It is but fitting, we believe, that public expression of our gratitude and reflection upon the merit of the plan be expressed here.

WE have had occasion from time to time to call attention to the fact that of all the so-called dead arts, that of development and production of ordnance is, in the popular mind, the deadest of them all—in peace. That it is so is unpleasant to record but none the less true. Human nature is to blame. There is no more reason, so one might conclude, why an active American business man, a time-pressed industrial executive, an over-burdened engineer—each of them crowded with the affairs of everyday life should busy himself about things for which there is no immediate necessity than there is that he should get excited over the announcement of some prehistoric finds in an excavation in Asia Minor. If these things are so, then how true that younger America at school engrossed in theory and experiment on the pertinent things of life should find little of interest in ordnance—in peace. The engineering student and his older professional counterpart cannot be blamed if such prosaic things as gun trunnions, fuzes, recuperators and the like have little appeal—in peace.

But what a different story it is in war. Ordnance then becomes everybody's concern. The student is anxious to shoulder it, the engineer to design it, the manufacturer to produce it, and even the gentle housewife in the role of munitions worker to help as best she can. Then it is that this presumably dead thing comes to life with a seriousness that demands the best of every one of us and, as is so often the case, our best intentioned help is a hindrance, our well-meaning desire a detriment. Better might the man in the street be made to realize that ordnance is not dead but slumbering to awaken—often when least expected—with a crash for good or ill. Today, thank heavens, the boom of cannon is heard in our land only to mark the rising of the sun and the going down thereof. Not eleven years ago in the third battle of Ypres more than four million shells were fired in a preliminary bombardment.

These reflections, we take it, are not new to members of the Army Ordnance Association. They know that it is only the ignoramus who calls ordnance a dead art. They know, many of them at least, what it means to face stark necessity when the cry everywhere is guns and ammunition and there is none to be had. They know the criminality of it all to have industry of the greatest industrial nation on earth proficient in everything but totally ignorant of the machinery of defense. And they know, too, the ever-present need of some vehicle for keeping alive an interest in and knowledge of munitions. But as we have taken occasion to point out before, their number is small, a mere four thousand among one hundred million. Their purpose, however, equals in importance that of every other patriotic class and surpasses many. To recruit their ranks patently is important. To assure those recruits from among the faculty of a great engineering school is foresight for the school, for the individuals concerned and for ordnance.

COLONEL SPRUANCE is pioneering in a field of tremendous importance. It is no new thing to train our students in discipline, tactics, strategy and organization through military methods. One has only to glance at the daily paper to note some new tirade against the "militarization" of our youth. The same un-American influences that would scuttle a navy would obliterate an army by a stroke of the pen and their first delimitation would be the abolition of military training in the schools. One can scarcely say then, that the field is not important. Military training and military schools are as old as the hills. The purposes of the Spruance endowment, however, are of a different character. Industrial preparedness is a newcomer on the scene; it has little historical background; there is no machinery for inculcating it. That the youth of the Nation should know of it through some such medium as Colonel Spruance has provided is as vital as it is novel. While pursuing their engineering studies they will have brought to them the place and responsibilities of the engineer—mechanical, electrical, chemical and metallurgical—in the field of munitions defense. Through membership in the Association they will be enabled to understand that this thing—ordnance—for which their fathers toiled in the World War as heroically as the men in the trenches, is the very crux of all national defense. They will be shown the constantly changing requirements of a field that is as big as our industrial power and which requires every jot and tittle of that power when we are at war. They will be given ample opportunity to witness the demonstrations of modern munitions as they are evolved and the more clearly visualize the mechanical and tactical import of armament.

And these are the purposes of the Spruance Endowment—the beginning, we hope, of a general and widespread movement, the logic of which we defy pacifists to refute.

Books

Navies and Nations. By Hector C. Bywater. Boston: The Houghton Mifflin Company. $4.00.

HERE is an important and opportune study of world naval problems by an accomplished British naval expert already favorably known for his articles published in America. This work is marked by a reasonableness only possible where scholarship comes before any cause.

Assaying the various navies defensively Bywater finds us in the strongest position, although noting our weakness in cruisers and Pacific bases. He considers the Japanese Navy chiefly defensive. While holding to the British view that the life of the Empire justifies an excess of cruisers, he admits that, practically, we have both the right and the means to maintain a navy equal to Britain's. From this he concludes that the greatest international good, limitation of navies, will come from actual naval parity between the British Empire and the United States.

The potentialities of navies in international politics and the naval concomitants of world trade rivalries are not emphasized. The international naval situation is here discussed very interestingly. This book will appeal to all who are interested in world affairs.

The Gonzaga—Lords of Mantua. By Selwyn Brinton. New York: Brentano's. 1928. $5.00.

AMONG the Italian communes of the Middle Ages Mantua is possibly less known than the majority of the city states of northern Italy. And yet in the vicissitude of its fortunes, in its internal feuds and warfare with neighboring republics, in its flowering of individual genius, it is no less interesting than the better known medieval cities. In his narrative of the Gonzaga dynasty, which flourished from the fourteenth to the seventeenth centuries and with which the story of Mantua is inextricably bound, Mr. Brinton has depicted in vivid and dramatic style the turbulent life of this community and the rise and fall of this great family. The splendid monuments in architecture, sculpture and painting that remain to this day are admirably described and illustrated and bear witness to the glories of the Italian Renaissance in this city state. The author has given us a comprehensive and authoritative study of a remarkable dynasty with the achievements of an equally remarkable commune as a background.

Life and I, An Autobiography of Humanity. By Gamaliel Bradford. New York: Houghton Mifflin Company. 1928. $3.50.

GAMALIEL BRADFORD has long been noted for his clever biographies and it is not surprising that he could produce this fascinating study of the human spirit in all its struggles for expression. The reader will understand himself and those about him more clearly by reading Bradford at his best in this book. He in turn takes up love, power, beauty, truth and religion and shows the influences they have had and do have on human life.

Some will differ with the author concerning his treatment of Christianity but every reader will find much food for thought throughout the book and, if at any time he feels that the author is at variance with him, he at least will agree that he writes with a masterful understanding of human life.

The Human Habitat. By Ellsworth Huntington. New York: D. VanNostrand Co. $3.00.

IT IS indeed difficult to imagine that a story of the varied influences which have caused the world to be peopled as it is both as to localities and as to races could be more charmingly and clearly presented than is done in this book. This subject has a most vital bearing from the industrial and political viewpoint. One who thoroughly understood it could foretell with a large degree of accuracy what the reaction to any innovations would be on a particular section of the world or on certain peoples; for example the success or failure of a commercial enterprise.

The author surveys the whole field from the ice ages to the present day, from the tropics to the polar regions, from the orient to the occident, and from the aborigines to the highest civilizations. It is to be expected that a careful observer and analysist would present many new thoughts concerning the far distant past but it comes more of a surprise when present day conditions are presented with the author's keen insight into the vital governing factors. This presentation assists the reader to understand the shifts of population and reasons for the varying modes of living now prevalent.

1928 Navy Manual. By Sloop of War Capt. D. B. Weyer. Munich: J. F. Lehmann. 1928. 15 marks.

TO WRITE much in praise of the Weyer Manual is unnecessary. Its contents, handiness and reliability regarding the recent data are known to all users. The new edition is a splendid production. It deals with all changes since 1926, to and including December, 1927, and contains 220 new illustrations, one-third of the photographic contents being brought up to date. As usual the statistical part, prepared in collaboration with the Hamburg-American Line, is very illuminating, dealing with the naval interests of all countries. The well known marine-political review is highly interesting. This review indicates more conclusively than even the tables and illustrations how little stock can be put in the rumors of disarmament; it shows how all countries with independent sovereign power are making their naval armaments as strong as possible.

Applied Elasticity. By S. Timoshenko and J. M. Lessells. East Pittsburgh: Westinghouse Technical Night School Press. $4.50.

THIS volume is divided into two parts; the first part being devoted to the theoretical development of the subject. Prof. Timoshenko has prepared this part in such

Just Published

Ordnance *and* Gunnery

By LIEUTENANT COLONEL EARL McFARLAND
Professor of Ordnance and Gunnery
United States Military Academy

With a foreword by
MAJOR GENERAL C. C. WILLIAMS
Chief of Ordnance, United States Army

This book presents simply and clearly the broader aspects of modern ordnance and gunnery. It assembles the fundamental and permanent theories of ordnance design. Complete descriptions and explanations of the materials used by our army during the World War and those developed since have been included.

The twenty-two chapters of the book cover . . . Propellants and High Explosives; The Theory of Explosives; Nitrogen for Explosives; Interior Ballistics; Proving Ground Instruments; Metals Used in Ordnance Construction; Guns; Recoil and Recoil Brakes; Artillery; Aiming Devices; Fire Control Instruments; Antiaircraft Aiming and Fire Control Devices; Exterior Ballistics; Firing Tables; Probability and Adjustment of Fire; Projectiles; Primers and Fuzes; Small Arms and Small-arms Ammunition; Machine Guns and Automatic Rifles; Motorized Matériel; Grenades; Chronological Outline of Ordnance Development.

611 pages, 6 by 9. Tables, diagrams, 282 illustrations. $6.50

JOHN WILEY & SONS, Inc., *Publishers*
440 Fourth Avenue **New York City**

Parts Cleaning

WHETHER large or small, metal parts and equipment can be cleaned best, the Oakite way. All oil, dirt, grease, old paint and similar deposits can be removed quickly, safely, and at low cost.

Oakite Service Men are available in all industrial centers to give expert advice on ANY cleaning job. Write us regarding your cleaning problems. No obligation.

Manufactured Only by

OAKITE PRODUCTS, Inc., 22 Thames St., New York

OAKITE
Industrial Cleaning Materials and Methods

manner as to make it of practical use to the designer in mechanical engineering. New methods which have been found to be acceptable are included. Numerous examples and excellent diagrams make it very clear and complete.

The second part is devoted to elasticity from the experimental viewpoint. Mr. Lessells, the author of this part, includes results of his own investigations as well as those of others, both in this country and abroad. The data on working stresses are collected in such manner as to be immediately available for use in design work.

The close collaboration of the two authors and the reviewing of the book prior to publication by prominent engineers has resulted in a most excellent and authoritative text and one which will doubtless be used extensively.

The Story of Chemistry. By Floyd L. Darrow. Indianapolis: The Bobbs-Merrill Company. $4.00.

HERE is another highly useful contribution to the popularization of science. After briefly reviewing the history of chemistry Darrow devotes separate chapters to the various phases of strictly modern chemistry. The author, a former educator, has the faculty of making difficult things clear and interesting. He further appeals to the majority by emphasizing the commercial value of modern chemical accomplishments. The information presented brings us well into 1927.

The Spell of Ireland. By Archie Bell. Boston: L. C. Page & Co. 1928. $3.75.

THIS is one of the best of the "Spell Series" which it has been our pleasure to read. The well known unique characteristics of the Irish race are presented in their natural setting and brought very close to the reader. The natural beauties of Ireland are pictured delightfully in Archie Bell's best manner. He has travelled the unfrequented roads and byways and sought out those more obscure places and peoples which are more often than not either unknown or unnoticed by the hurried traveler. Thus he is able to portray much of the romance, history and folk lore of the country side which is usually unheralded. He also gives a fair picture of the economic status of the new Ireland and an indication of the trend of what may be termed the Irish renaissance. It would be an unusual reader, indeed, who would finish this book without a clearer understanding of and more sympathetic attitude towards this tiny struggling nation whose beauty and romance clings tenaciously to its sons and daughters wherever dispersed about the earth.

Military Operations—France and Belgium, 1914. Vol. I of the History of The Great War based on official documents. Compiled by Brig. Gen. J. E. Edmonds. London: Macmillan & Company. 21 shillings. Separate case containing 34 general, battle, and situation maps—21 shillings. By direction of the Committee of Imperial Defense.

THIS is the first of a series of about 10 volumes to be published on the military operations of the British Forces in France and Belgium during the Great War. It has been carefully prepared from official documents, checked by participants, and verified by comparison with the German records. Enough of the operations of the French and Belgians are included to provide a framework for the British operations.

This volume covers the period from the outbreak of the

war until the withdrawal of the B. E. F. from the Aisne and its transfer to the Flanders front 1—14 October, 1914. An introduction gives the organization and composition of the British, French, Belgian and German forces.

The first battle at Mons, the battle of Le Cateau, the retreat to south of the Grand Morin, the battles of the Marne and the Aisne are covered in detail.

This volume treats the action of the battalion, the squadron and the battery as the basis of the story. The author explains that this is done in view of the importance of small units in the early stages of the war and of the lessons to be derived from the study of the work of these units in open warfare. No doubt the form of organization of the British Army at the time had its influence on the form taken.

Our interest is centered on the pursuit of the Germans from the Marne to the Aisne. With a gap between the First and Second German Armies as wide as 18 miles on 13 September covered only by three cavalry divisions, an opportunity was presented the British to drive in between and separate the two forces while the Sixth French Army on the British left attacked Von Kluck. In spite of a defense of the British action, one is forced to conclude that an advance of a few more miles per day might have brought disaster to at least one of Germany's armies and possibly severe losses to another.

The volume is well supplied with sketches of the operations for use by the general reader. A series of general battle and situation maps are furnished in a separate case for the use of the student. This history will form a valuable addition to the battle literature of the Great War.

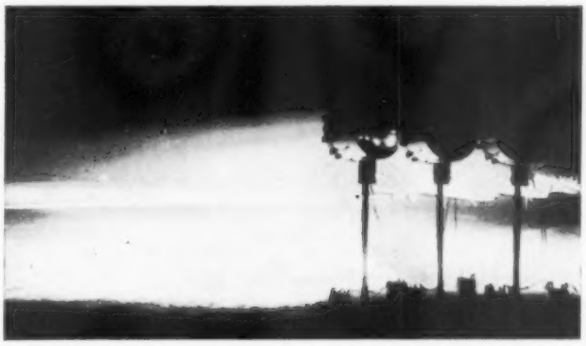
Smokeless Shotgun Powders, Their Development, Composition and Ballistic Characteristics. By Wallace H. Cox. Wilmington, Del.: E. I. du Pont de Nemours & Co. 1928.

THIS booklet, which was prepared by Wallace H. Cox, ballistic engineer of E. I. du Pont de Nemours & Co., is a comprehensive manual, which, as the author declares in his preface, is "intended for the use of the shooter who desires a better understanding of his ammunition."

All types of shotgun powders are analyzed, including black powder, smokeless powder, bulk powders, dense powders, development of progressive burning powders, powders for heavy loads, and powders for light loads. Such technical problems as pressure curves, strength, velocity, barrel time, hygroscopicity, storage, stability, temperatures, patterns, "energy" and mixtures are discussed in non-technical language.

An interesting feature of the booklet is a division devoted to the discussion of shotguns themselves. Such things as gages, chambers, the forcing cone, the fitting of the length of the shell to the chamber length, the choice of the degree of choke, the thickness and length of the barrel, the reboring of guns, the weight, the burst, the pattern and the cleaning and care of shotguns, are covered in interesting and up-to-date fashion.

Another section of the manual is given to an analysis of shotgun shells, where every problem from the crimp, wad and primer to the sizes of shots are reviewed from the standpoint of the expert. The book contains an interesting table on the speed of game birds in flight and a comprehensive bibliography covering a score or more of the latest volumes on guns, shooting and explosives.



for

"Three Point" Night Landings

The ocean wayfarer is not the only navigator who is warned of danger and guided safely into port by never-failing beacon lights. The aviator, too, is directed along a safe route to his port by dependable illumination.

In the development of effective and economical airport lighting, Westinghouse has played an important part. Westinghouse floodlight projectors sweep the landing field with a soft, nonglaring light, showing the pilot every surface condition.

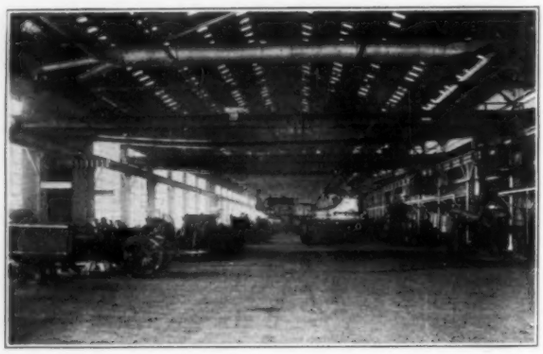
Westinghouse also manufactures micarta propellers for various types of planes. These propellers are extremely durable and light in weight. They have adjustable pitch and are unaffected by moisture or change in temperature.

Westinghouse Electric & Manufacturing Company

East Pittsburgh, Pennsylvania

Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse



20 ton P&H Crane at U. S. Arsenal—Watertown, Mass.

P&H Electric Traveling Cranes

THERE are more P&H Electric Traveling Cranes in use today than any other make.

The fact, that many users have from 10 to 270 cranes in use, is convincing testimony to the skill and experience which enters into each detail of P&H crane construction.

Our booklet 408-R tells an interesting story. May we send it?

HARNISCHFEGER CORPORATION
MILWAUKEE WISCONSIN
Founded in 1884

COLUMBIA STEEL CORPORATION

Manufacturers of

STEEL PRODUCTS

CASTINGS BARS ANGLES LIGHT SHAPES

SHEETS BLUE ANNEALED BLACK AND GALVANIZED

WIRES BRIGHT - ANNEALED - GALVANIZED BARBED - WOVEN NETTING

NAILS BRIGHT - BLUED - CEMENT COATED GALVANIZED - PURE COPPER

TIN PLATE

WIRE RODS, STAPLES, TWISTED WIRE HOOPS

IRON ORE - PIG IRON - COAL - COKE

WESTERN MADE COLUMBIA STEEL PRODUCTS

PLANTS

Pittsburg, Calif. Torrance, Calif.
Portland, Ore. Ironton, Utah

SALES OFFICES

San Francisco, Calif. Los Angeles, Calif.
Portland, Ore. Seattle, Wash.
Salt Lake City, Utah Phoenix, Ariz.

About Ourselves, Psychology for Normal People. By H. A. Overstreet. New York: W. W. Norton & Co., Inc. 1928. $3.00.

NEARLY three hundred years ago Gracian wrote: "You cannot master yourself unless you know yourself. There are mirrors for the face but none for the mind." In this book Professor Overstreet has gone far to provide a mirror for the mind based on the truths revealed in the last half century by scientific research in the domain of psychology. It will not be difficult to recognize some of our idiosyncrasies in the description of the slight aberrations usually found in normal people. The author, of course, disclaims offering any panacea for all our mental ills, but he points the way, with a sympathetic understanding of the difficulties in the path, to the development of personality "by reconditioning and reinvigorating the entire psychical constitution."

Every reader will owe Professor Overstreet a debt of gratitude, not only for a better knowledge of himself, but also for a broader understanding of human nature. One would willingly wade through a dry-as-dust volume to attain this knowledge, but we find here a charming and vivid style that carries us along with delight to the very end.

Economic Institutions. By Willard L. Thorp. New York: The Macmillan Co. 1928. $1.50.

MOMENTOUS changes will undoubtedly occur in the present money and profit economy in future years. Whether they will be of an evolutionary rather than a revolutionary character will depend to a great extent on the knowledge the general public has of economic fundamentals.

In this successful effort to meet the demand for a popular yet authoritative book on economics, Professor Thorp considers the present economic system under four headings, i. e., machine technique, the price system, private property and business enterprise. The author insists throughout on the continual reshaping and modification of our economic order. His remarks relative to the defects of our present organization and methods are impartial, and his treatment of controversial subjects is broad and without bias. The beginner will find in this book a very readable, adequate and accurate treatise on economic institutions which will provide an excellent introduction to more extensive studies.

The World of Atoms. By Arthur Haas, Ph. D.; Translated by Horace S. Uhler, Ph. D. New York: D. Van Nostrand Co. 1928. $3.00.

THIS is a very remarkable book, first in that in the ten short lectures of which it is composed so much is included of the advanced views and theories of the outstanding authorities of physical science and second in that these highly scientific matters are explained so simply and clearly that those uninstructed in atomic mechanics can read concerning them understandingly. Dr. Haas has a comprehensive grasp of the present day theories of the structure of the atom and shows that much is to be accomplished by extending our present knowledge sufficiently to permit of utilizing some at least of the enormous amounts of energy in the atom which are so far unavailable for exterior utility.

Dr. Uhler has given a very acceptable translation and in so doing has rendered a signal service and one which

will help to advance a more general understanding of quantum mechanics which in the future will undoubtedly be of momentous importance.

Soldier of the South: War Letters of General Pickett to His Wife. Edited by Arthur Crew Inman. Boston: Houghton Mifflin Company. 1928. $2.50.

THE name and fame of General George E. Pickett will last as long as Gettysburg. These intimate letters to his wife reveal the true nature of the soldier who led the charge, and the Southern gentleman who loved and married in the midst of war. The volume contains much new material obtained from Mrs. Pickett and never before published. There are vivid and moving descriptions of marches and skirmishes, of tragi-comic incidents of army life, of great battles, and of a visit after the war to his old friend U. S. Grant.

The book is in the best sense a human document, a dramatic description from behind the scenes of one of the crucial periods of American history. Few collections of letters can claim at once such ingenuous charm and such importance of subject.

Students of the Civil War, sons of the Confederacy, and all who appreciate an authentic first-hand narrative of great events will enjoy this stirring volume.

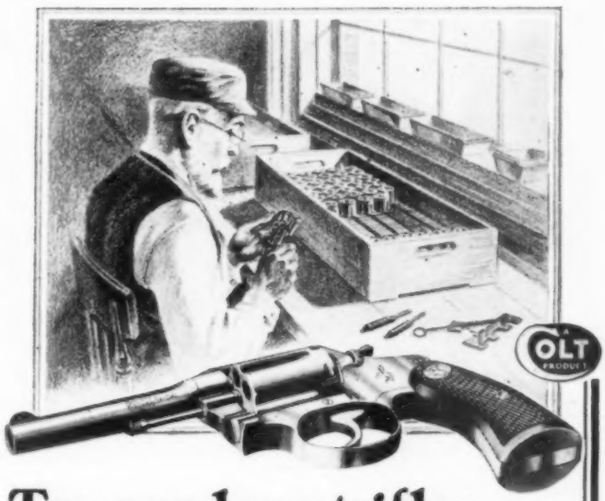
Everybody's Aviation Guide. By Major Victor W. Pagé, U. S. Air Corps Res. New York: Norman W. Henley Publishing Company. $2.00.

IF AVIATION is to become the accepted method of high speed transport of the future, it is essential that the American public becomes air minded, which means that it must be as fully conversant with the various details of flying as it is with motoring. This knowledge cannot be obtained by reading technical and specialized books intended only for the engineer or the scientific hobbyist because the average man is practical rather than technical, even though he be an enthusiast about flying. The method of giving instruction by means of questions and answers has been followed by many writers in the past as it is a method of presentation particularly suited to the layman.

In this latest book, Major Pagé has collected numerous questions that were asked of him while he was an instructor at the U. S. Army aviation fields, and has grouped them in a series of lessons that are logically arranged and easily understood as they are written in simple language. While the answers are, for the most part, brief, they suffice to give the information that the average person desires about all phases of aircraft construction and operation. This treatise is a very good introduction to the subject as it not only outlines the principles by which various airplanes and dirigible balloons navigate the air, but it also considers the various features of design, the relation of the various parts to each other and how all the auxiliaries function.

A Subaltern on the Somme. By Mark Seven. New York: E. P. Dutton & Co. $2.00.

THIS is a wonderfully interesting and realistic account of the life and duties of a British company officer at the front from July, 1916, until he was returned to England wounded in January, 1917. The book is candidly written and without exaggeration of the monstrous. It



Tremendous trifles..

Every COLT must pass hundreds of actual gauge and visual inspections. Some of these may seem trifling and unimportant. Yet, it is this infinite care which places every Colt—and every Colt owner—on the safe side.

Since 1836—the World's Finest Arm

COLT'S PATENT FIRE ARMS MFG. CO.
Hartford, Conn.

save money on
STAMPINGS

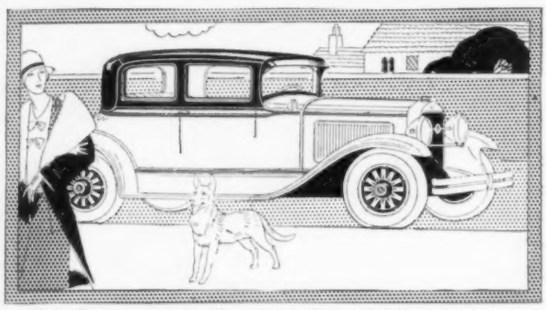
No matter what their size or shape, you can produce them better, faster, and at less expense if your presses are equipped with

MARQUETTE DIE CUSHIONS

in use all over the world

There's now a size and type of cushion for every type of press, for every sort of metal drawing job. To find out how little installation would cost and how much it would help, send us sample shell, or a blue print of the part or parts you make.

Marquette TOOL & MFG. CO.
1900 N. Kilbourn Ave.
Chicago



NEW COMMANDER SIX VICTORIA *for Four, $1375 at the factory Bumpers extra*

STUDEBAKER'S great new eights and sixes hold every official stock car record for speed and endurance. And the qualities that make such performance possible are splendidly interpreted in body designs of striking beauty. There is fleetness and eagerness and untiring endurance in each low-swung line and fluent curve. There is a revelation awaiting you in your first scrutiny of what Studebaker's unique One-Profit manufacture has wrought.

STUDEBAKER

Builder of Champions

365

DAYS

After a year of average use a radio receiver should have a complete new set of RCA Radiotrons. Worn tubes should not be left in with the new ones.

RCA

RCA RADIOTRON

"Radiotrons are the Heart of your Radio Set"

rings true. A clearer description of what the infantryman had to contend with cannot be written. The author says in his introduction, "All that is sufferable in the way of reminiscence must be truth expressed through personality," and this he has done in a most understanding and readable manner.

The clearness, conciseness and personal touch of the book holds one's interest through all its gruesome details. Its completeness is very satisfying and one regrets keenly that the author is wounded and must return to England, thus closing this intimate personal history.

This book has been much praised in England and will receive very favorable comment in this country. Few books of just this character, dealing with the World War, will be produced. An experience common to millions but few have the ability to describe it as Mark VII has done.

Psychology and the Soldier. By F. C. Bartlett. New York: The Macmillan Company. 1928.

EVERY officer is faced from time to time with concrete problems of the relation of punishment to discipline, the limitation of freedom of action, the development of morale and numerous allied questions of psychological nature. Mr. Bartlett, the director of the psychological laboratory of the University of Cambridge, has written a most helpful book which should be read and applied by everyone in authority in the military service. The selection and training of recruits is first dealt with; then the modification of the individual's conduct due to membership in a group is followed by a study of morale and leadership. Mental disorders due to the storm and stress of battle are studied briefly.

Voltaire, Genius of Mockery. By Victor Thaddeus. New York: Brentano's. 1928. $5.00.

THIS interpretation of Voltaire emphasizes the best side of this enigmatic philosopher and rather minimizes the defects of his character. Mr. Thaddeus shows us a consistent champion of mankind against oppression by church and state. We hear much of the battle cry "crush the infamous thing," referring to the church of his day. But it is not made equally clear that Voltaire wrote elsewhere "a religion is needed for the people." Voltaire's hatred of war is dwelt upon, but there is no mention of him as the inventor of the so-called "Assyrian chariots" for use in war. As a matter of fact, in every phase of his philosophy and writings he is an epitome of contradiction. And this is not sufficiently brought into evidence. There are voluminous quotations from Voltaire's books and letters which reveal his unsatiable curiosity, and his clear and vivacious style. The book should result in making Voltaire more widely read as it has the merit of whetting the appetite for a closer acquaintance with the works of this remarkable man.

The Fundamentals of Military Strategy. By Oliver P. Robinson, Lt. Colonel, Infantry, U. S. Army, Washington, D. C. U. S. Infantry Association 1928. $3.00.

MUCH has been written on strategy—much that is dull and indifferently presented. Consequently an adequate and authoritative manual on this subject prepared in a readable fashion is a welcome addition to the military library. Colonel Robinson has achieved this desirable end in a book which no one interested in military affairs can

afford to neglect. It is a simplified and logical study of the fundamental ideas of strategy, illustrated throughout by apt instances of warfare, taken more especially from the Civil War, the Franco-Prussian War, and the World War operations.

Stonewall Jackson—The Good Soldier. By Allen Tate. New York: Minton, Balch and Co. 1928. $3.50.

MR. TATE has evidently made every effort to become thoroughly familiar with Jackson's early surroundings —his opportunities for education or lack of them—his environment and its effect on him throughout his whole life. Mr. Tate has loved Jackson long and well and interprets him with deep affection and keen understanding.

Jackson, even in his youth, had great determination and though unfitted educationally for West Point, to West Point he must go. He said at that time, "I am going to make a man of myself if I live. I can do anything I *will* to do." This determination and belief in himself guided him well and aided him in his brilliant accomplishments on the battlefields against almost overwhelming odds. He had great vision and could grasp conditions with extraordinary clearness and exactitude. His extreme religious fervor combined with his unusual genius in military matters make him very interesting to the biographer.

How to Criticize Books. By Llewellyn Jones. New York: W. W. Norton & Co., Inc. 1928. $1.75.

WHEN the literary editor of *The Chicago Evening Post* unveils the mysteries of his profession, he deserves profound attention. He will surely get it in this book which is the result of fourteen years' experience in writing and editing book reviews. Not only does it provide a surer basis for judging the various forms of literary expression, but it suggests means of improving one's style of writing.

The first two chapters dealing with the use of words and "turning the sentence" indicate pitfalls to be avoided and constructively point the way to more effective writing. The discussions of the various forms of literature—biography, poetry, fiction, the short story, drama, clarify the point of view of the book critic. Additional chapters on such subjects as method of collecting facts and the distinction between reviews and criticisms make this a most valuable book for a wide class of readers.

Hotel Astor
TIMES SQUARE NEW YORK CITY

Headquarters while in New York—Special Discounts on Rooms to all Army Officers.

FRED A. MUSCHENHEIM

The Modern Genie of Aladdin's Lamp!

As remarkable as any of the magic of the Arabian Nights are excavating machines dwarfing the giant genie of Aladdin's day and responding to the operator's lightest touch. They remove mountains, build islands, change deserts to fertile plains, dam rivers, and unite oceans.

On such stupendous tasks as the Lloyd's Barrage, Suflej River Irrigation Project, The Welland Canal, Sudan Irrigation, Salonika Plains Drainage and a host of other great earth-moving projects Bucyrus-Eries predominate. Here as well as in open pit mines and quarries, in clay and gravel pits, on highways and railroad grades, construction of canals, channels and harbors, in alluvial mining and overburden removal, excavating for basement and sewers—they demonstrate trouble-free operation and lowest unit cost production.

BUCYRUS-ERIE COMPANY
GENERAL SALES OFFICES: SOUTH MILWAUKEE, WIS.
Works: South Milwaukee, Wis.; Erie, Pa.; Evansville, Ind.

BUCYRUS ERIE

Representatives and service throughout U. S. A. and Canada. Offices and agencies in all the principal countries throughout the world.

CHASE

In the Brass and Copper Business
——— A NEW TRADEMARK

This distinctive figure of the bronze age (illustrative of the Chase), is the new mark of the *Chase Brass and Copper Co., Incorporated.*

You are going to see a great deal of it. This new chase mark will be used on all our shipments of Brass and Copper products such as Sheet, Rod, Wire, Tubing, Stampings, Screw Machine Products, etc.

See that your supplies in Brass and Copper bear the Chase mark—the sign of a *good* product.

Chase Brass & Copper Co.

Waterbury, CHASE Connecticut

New York Newark Rochester Boston Philadelphia Pittsburgh Cincinnati Chicago Cleveland Detroit St. Louis Baltimore New Orleans Dallas San Francisco Los Angeles

AMERICAN MANGANESE STEEL CO.
Chicago Heights, Illinois

America's Part. By Brig. Gen. Henry J. Reilly, O. R. C. New York: Cosmopolitan Book Corporation. 1928. $3.50.

THIS is a timely book which answers conclusively the major questions bearing on the magnitude and effect of the part America played in World War. The author is well qualified to discuss these questions, as is ably set forth by Maj. Gen. J. G. Harbord in the preface. The book is well written in a style which will appeal to those busy readers who are looking for clear and concise answers to questions concerning: the task which confronted General Pershing; why Germany defied the United States; the use of American troops in the armies of the Allies and the fighting spirit displayed by those men; the ability of the American commanders; the decisive day and battle of the war; and the decision of the Allies to select a supreme commander-in-chief and the effect of this decision.

Mechanics for Engineers, Statics and Kinetics. By Julian C. Smallwood and Frank W. Kouwenhoven. New York: D. Van Nostrand Co. 1928. $2.50.

THIS book on mechanics has been prepared by the authors in order to furnish for the use of college students a text which is in conformity with modern methods of teaching and the demands of industrial requirements. It is confined to the dynamics of assumed rigid bodies and is purposely made brief so as to be susceptible of proper presentation in present-day college instruction. An effort has been made to stress the physical interpretation of the equations and laws presented and many problems which require the application of the principles demonstrated are included, together with approved answers.

HERCULES
SPORTING POWDERS
HERCULES POWDER COMPANY
(INCORPORATED)
Wilmington, Delaware

The Medal of the Army Ordnance Association

Medal struck from bronze of captured cannon
Ribbon of grosgrain silk, scarlet, yellow and black.
For sale to members only. Price $1.00.
THE ARMY ORDNANCE ASSOCIATION
The Mills Building
WASHINGTON, D. C.